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FORTY-SEVENTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

TWELFTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

1899.

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State Board of Agriculture, 1900.

Members ex Officio.

His Excellency W. MURRAY CRANE.
His Honor JOHN L. BATES.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
JAMES W. STOCKWELL, *Secretary.*

Members appointed by the Governor and Council.

	Term Expires
DWIGHT A. HORTON of Northampton,	1901
WILLIAM R. SESSIONS of Springfield,	1902
FRANCIS H. APPLETON of Manchester,	1903

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1903
Barnstable County,	JOHN BURSLEY of West Barnstable,	1901
Berkshire,	WESLEY B. BARTON of Dalton,	1903
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1903
Bristol County,	EDWARD M. THURSTON of Swansea (P. O. South Swansea),	1902
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Eastern Hampden,	O. E. BRADWAY of Monson,	1903
Essex,	JOHN M. DANFORTH of Lynnfield (P.O. Lynnfield Centre),	1902
Franklin County,	F. L. WHITMORE of Sunderland,	1901
Hampshire,	GEO. P. SMITH of Sunderland,	1901
Hampshire, Franklin and Hampden,	H. C. COMINS of Hadley,	1903
Highland,	C. K. BREWSTER of Worthington,	1902
Hillside,	ALVAN BARRUS of Goshen (P.O. Lithia),	1902
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1903
Hoosac Valley,	GEO. P. CARPENTER of Williamstown (P. O. Blackinton),	1903
Housatonic,	CHARLES B. BENEDICT of Egremont,	1903
Man'f'trs' Agr'l (No. Attleborough),	OSCAR S. THAYER of Attleborough,	1903
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1903
Martha's Vineyard,	EVERETT A. DAVIS of West Tisbury,	1901
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1903
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1903
Middlesex North,	JOSHUA CLARK of Tewksbury (P. O. Lowell),	1901
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1902
Nantucket,	J. S. APPLETON of Nantucket,	1903
Oxford,	H. H. SIGOURNEY of Oxford,	1901
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1902
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1901
Union (Agr'l and Hort'l),	ALMON W. LLOYD of Blandford,	1901
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1903
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1902
Worcester East,	W. A. KILBOURN of South Lancaster,	1903
Worcester North-west (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P. O. Athol Centre),	1901
Worcester South,	C. D. RICHARDSON of West Brookfield,	1901
Worcester County West,	CHAS. A. GLEASON of New Braintree,	1902

THE FORTY-SEVENTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The Massachusetts State Board of Agriculture, at the close of another year of counsel and work, has met in annual session to review and gather up the lessons of the past, and to devise means and study methods for greater usefulness to agriculture in the year to come. The position this Board now holds in the farmers' esteem, the confidence reposed in it by the Legislature of the State, and the appreciation of our labors, as recorded in our annual report, — which is sought for throughout our own country and from many of the nations of the old world, — should incite us to do our best work, that the record shall be honorable, instructive and valuable. The secretary would only suggest that the several reports which by law are included in the report of the Board of Agriculture, be as condensed and as concise as consistent with a fair presentation of the topic, that they may be more generally read by the people. The farmer who does not study carefully these several reports, will lose a thorough understanding of the present methods, conditions and results in agricultural work and investigation, and will not appreciate or understand the work of this Board of Agriculture.

Gift to the Board.

In response to its request, the Board has received a large and richly framed portrait of its second secretary, — Hon. John E. Russell of Leicester. It is a crayon drawing, executed by Miss Emeline Wing of Boston, and is a faithful portrait of Mr. Russell as he appeared when secretary of the Board, 1880–87. It was well hung by Mr. Noyes of Boston, in good position and good light. All who have seen it praise it highly as a portrait and as a work of art.

The formal thanks of the Board were duly forwarded to Mr. Russell in his distant sojourn; but the brightening eye and the glad expression of pleasure from the members who were associated with Mr. Russell when he was its secretary are more eloquent of the pleasant remembrances of past association than words can portray. Mr. Russell can be well assured that no place is so distant that it is not reached by the kindest thoughts of the members of the Massachusetts Board of Agriculture.

Changes in the Board.

The loved and efficient secretary of the Board, Hon. Wm. R. Sessions, declined further service, and his resignation was reluctantly accepted at the last annual meeting, and Hon. J. W. Stockwell was elected as secretary of the Board, his term to begin July 1, 1899. The office was vacated by Mr. Sessions June 30, 1899, and all valuables placed in the hands of his successor. The correspondence that follows is self-explanatory of the courtesies of the exchange: —

Hon. J. W. Stockwell. Boston, Mass., June 30, 1899.

My Dear Sir: — The time has arrived for me to lay down the responsibilities of the office of secretary of the Massachusetts State Board of Agriculture, after twelve years of the best service I have been able to render. I am glad to be succeeded by an experienced and loyal friend of agriculture and of the men and women who pursue that most honorable calling. It is also most agreeable to me to be succeeded by a personal friend, — one who has for many years been associated with me in the work of the Board of Agriculture and the Dairy Bureau, as well as in grange and institute work. I am sure you will be successful in the

earnest efforts I know you will put forth for the good of the farmers of Massachusetts and for our grand old Commonwealth, and that the Massachusetts Board of Agriculture will, under your guidance, grow in usefulness and in the estimation of the people of the State.

Yours very truly,

(Signed) Wm. R. Sessions,
Secretary.

Boston, July 1, 1899.

Hon. Wm. R. Sessions, *Secretary, State Board of Agriculture.*

My Dear Secretary: — I thank you for your kind words and more for the friendship that prompts them. I take up the work you have laid down with greater courage because I know your interest will still be with the old Board you have so faithfully served these twelve years, and that I can call on you for information and counsel in all the work that centres here.

I can go back with you to the simpler conditions when you assumed the position. I realize its gradual unfolding and growth to its present proportions, and it has all come about so quietly that the farmers of the State do not fully know its magnitude nor the value of the work done for them and for the broader field of agriculture.

You have had a united Board to sustain you from the first year to the last, when we so reluctantly accepted your resignation, and the work you have done praises you and reflects credit on the Board of Agriculture. How much pleasure you can take with you as you look back on the work you have accomplished and see its far-reaching results! If I may carry on this task, nor let the good work of the Board fail nor its influence decline, I shall be satisfied. The lines in which we have walked for the past twelve years with such good results are safe to follow. New avenues will open before us; new duties will come to us; these we will try and meet faithfully. And now, good friend, may rest and health come to you and yours and abide with you many years. You go with the heartfelt blessing of every member of this good old Board; for them and in their behalf I say, God bless you.

Yours most truly,

(Signed) J. W. Stockwell.

On January 12 Mr. S. S. Stetson of Lakeville, a member of the Board by appointment of the Governor, died of pneumonia. Mr. Stetson had been very devoted in his work for the Board and cordial in all his relations with the members,

and his loss was keenly felt. His work on the gypsy moth committee was painstaking and valuable, and he gave of his time and strength freely in this work. Gen. Francis H. Appleton of Manchester was appointed to fill the vacancy on the Board, and Mr. John M. Danforth of Lynnfield was elected by the Essex Agricultural Society to fill the unexpired term made vacant by the appointment of General Appleton.

Mr. H. H. Sigourney of Oxford was elected by the Oxford Agricultural Society to fill the unexpired term of Mr. J. W. Stockwell, resigned.

Mr. J. Elton Green of Spencer, member of the Board from the Spencer Farmers' and Mechanics' Association, resigned from the Board, and Mr. John G. Avery of Spencer was elected to fill out his unexpired term.

The other changes in the Board will be noted by the report of the committee on credentials.

Delegates to the Board.

The Massachusetts Board of Agriculture has large and important trusts and duties placed upon it by the wisdom of the State, and this Board has never failed, but has held its high position with increased favor with each session of the Legislature, and added responsibilities have followed. We may well be proud of this confidence, and labor even more diligently for the good of the agriculture of the State; and to do this it becomes more and more incumbent on the agricultural societies to select their best men for service on this Board, and, when selected, to retain them here for the benefit it will bring to the Board and for the greater influence and resultant good to the State.

Meetings of the Board.

A special business meeting of the Board was held at Boston, March 28, 1899, an account of which will be found on pages 11–14. A special meeting was held at Boston, October 4 and 5, during the session of the Farmers' National Congress, the members being, by appointment of the Governor, associate delegates to the said Congress. The public winter meeting for lectures and discussions was held at

Westfield, December 5, 6 and 7. The meeting was considered a very successful one in all respects, the officers of the Union Agricultural and Horticultural Society and the people of Westfield cordially contributing to the pleasure and profit of the meeting. The lectures and discussions will be found printed on pages 25–205 of this volume. A special business meeting was held at Westfield, December 5, an account of which will be found printed on pages 14–21. The annual business meeting was held at the office of the secretary, Jan. 9 and 10, 1900, and the minutes thereof, etc., will be found printed on pages 209–257 of this volume.

Agricultural Societies.

The returns of the societies will be found printed on pages 529–555 of this volume. A summary, contrasting the totals of 1897, 1898 and 1899, is printed on page 556 of this volume.

During the past year, three societies have sold a part or all of their real estate, and two societies have found it advisable to place mortgages on their real estate. These several transactions have been with the approval of the Board of Agriculture, in conformity to the provisions of chapter 274 of the Acts of 1890, and will be found recorded in the minutes of the Board and of the executive committee of the Board, in this volume.

The Worcester Agricultural Society has purchased new grounds, pleasantly and conveniently located, well laid out and adapted for the several uses for which they have been prepared. This society, having a large interest-bearing reserve fund, and located in the heart of the Commonwealth, should be able and doubtless will do advanced work for the benefit of agriculture, or take up experimental lines in connection with its annual fairs and exhibitions that poorer societies could not with prudence risk. We believe this old society will be true to its opportunities, and give the State its best efforts.

Farmers' Institutes.

During the year 1899, 123 farmers' institutes were held. These meetings were addressed by 76 different speakers, selected for the most part from the list of available lecturers

prepared under the direction of this Board. Seven societies held more than the 3 institutes required by rule of the Board. The attendance at the institutes was most gratifying, returns from 109 showing an average attendance of 94. Some few societies still continue to hold institutes with from 5 to 30 persons in attendance. During the year 8 institutes were held under the auspices of other than incorporated agricultural societies. It is but fair to say that the attendance and interest at these meetings were satisfactory, the attendance averaging 148.

Lecturers were furnished by this office for 97 institutes, at a total cost of $1,510.11 for services and expenses, — an average of $15.57 per institute.

Scales of Points or Score Cards.

Rule 8 of the Board is as follows: "Each society drawing bounty shall adopt the scale of points established by the Board of Agriculture, in awarding the premiums on live stock, vegetables and fruits, to the end that there shall be uniform modes throughout the State."

Very few of these cards have been called for the past year, the principal requests being from agricultural colleges for use in class work. It is believed that these score cards should be placed in the hands of all the judges at our fairs, that points of excellence according to a correct standard may receive deserved commendation, and that exhibitors may be encouraged to bring only the best types in the several classes.

Farmers' National Congress.

The nineteenth annual session of the Farmers' National Congress of the United States was held in Boston, at Faneuil and Horticultural halls, October 3–10. The Board of Agriculture at its last annual meeting appointed Gen. Francis H. Appleton, J. W. Stockwell, W. A. Kilbourn, John G. Avery and R. G. F. Candage as a committee of arrangements for the session of the Congress. This Congress was well attended by the agriculturists of New England, and the broader exchange of ideas and the opportunity of personal acquaintance with the prominent and

progressive farmers from every part of the country must result in great good to our people. Two thousand copies of the official proceedings of the Congress were printed under the direction of the committee and have been partially distributed. A fuller report of the committee of arrangements will be found on pages 517–525 of this volume.

Publications.

The following publications were issued by this office in 1899, and may be obtained on application: —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1898, .	819*	15,000	May 12.
Crop Bulletin No. 1, May, . . .	32	2,700	June 6.
Crop Bulletin No. 2, June, . . .	40	2,500	July 3.
Crop Bulletin No. 3, July, . . .	40	2,700	Aug. 3.
Crop Bulletin No. 4, August, . .	40	2,500	Sept. 8.
Crop Bulletin No. 5, September, . .	40	2,500	Oct. 5.
Crop Bulletin No. 6, October, . .	38	2,500	Nov. 3.
Catalogue of office library, . . .	128	500	Aug. 4.
Farmers' institute pamphlet, . . .	14	700	Dec. 16.
Proceedings Farmers' National Congress.	191	2,000	Dec. 18.

There were also issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1898: "What the experiment stations have learned about raising and curing tobacco," by Dr. E. H. Jenkins; "The mission of the agricultural colleges," by Dr. W. H. Jordan; "The love and study of nature: a part of education," by Dr. G. Stanley Hall. Also, the following excerpts from the "Proceedings of the Farmers' National Congress:" "Decline of farm lands in the east: cause and remedy," by Hon. J.

* Including eleventh annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 172 pages.

W. Stockwell; "Teaching of the elements of agriculture in the common schools," by Hon. C. C. James; "Good roads: advantages of State aid to farmers," by Hon. Wm. W. Armstrong; "The necessity of pure food legislation," by Hon. H. C. Adams. Also "Obligations of wealth," by Ex-President Benjamin Harrison.

Gypsy and Brown-tail Moths.

The sum of $200,000 was appropriated by the Legislature of 1899 for continuing the work against these insect pests. Of this amount, $190,000 was for gypsy moth work and $10,000 for brown-tail moth work. The report of the committee in charge will be found printed on pages 341–388 of this volume. This report is vastly important to the people of this State. It is not a question of farmers or of farming, but affecting every town and city, — the beauty of parks, reservations, streets and homes. We earnestly ask that this report be carefully studied, that we may deal wisely with this dangerous pest.

Forestry and Roadside Improvement.

The appropriation for the purchase of M spikes and washers was the usual $200, which was expended. Spikes and washers were supplied during the year to the towns of Andover, Bedford, Bolton, Brookfield, Leicester, New Braintree, Northbridge, Rutland, Sandwich, Shirley, Spencer, Ware and Warwick. Since the work of supplying these spikes was begun, Dec. 26, 1891, five cities and seventy-seven towns in the Commonwealth have requested and received varying quantities of the spikes. It is estimated that there have been furnished 190,000 spikes, with accompanying washers, during the period named.

This office will, if you approve, bring to the notice of all towns that have not accepted the law, which now becomes imperative, the importance of this method of roadside improvement. It costs nothing comparatively, and its results will be an increasing shade and an added beauty to the streets and highways of the State.

Legislative Appropriations for Agricultural Purposes.

Objects for which appropriated.	1897.		1898.		1899.		1900.
	Appropriated.	Used.	Appropriated.	Used.	Appropriated.	Used.	Appropriated.
Bounties to societies,	$21,000 00	$20,344 68	$21,000 00	$19,933 17	$19,800 00	$18,871 51	$19,800 00
Travelling and necessary expenses of the Board,	1,900 00	1,527 92	1,900 00	1,291 27	1,900 00	1,490 20	1,900 00
Travelling and necessary expenses of the secretary,	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Incidentals in office of secretary,	800 00	800 00	800 00	800 00	800 00	800 00	800 00
Salaries of secretary and clerks,	5,300 00	5,300 00	5,500 00	5,500 00	5,500 00	5,500 00	5,500 00
Dissemination of useful information in agriculture by means of lectures or otherwise,	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00
Printing 15,000 copies of the "Agriculture of Massachusetts,"	6,100 13	6,100 13	5,748 69	5,748 69	5,442 52	5,442 52	*6,000 00
Collecting and circulating information relative to abandoned farms,	† 727 00	419 54	–	–	–	–	1,000 00
Carrying forward work of Dairy Bureau,	7,000 00	7,000 00	7,000 00	6,389 35	7,000 00	7,000 00	7,000 00
Salary of executive officer of Dairy Bureau,	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Salary of assistant in work of Dairy Bureau,	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00
Nails or spikes for marking shade trees for preservation,	200 00	47 17	200 00	–	200 00	174 11	200 00
Aggregates,	$48,027 13	$46,539 44	$47,148 69	$44,662 48	$45,642 52	$44,278 34	$47,200 00

* Estimated. † Unexpended balance.

Also the Legislature of 1899 made the following regular annual appropriations: for maintaining an agricultural experiment station at the Massachusetts Agricultural College, $10,000; for the said college, for free scholarships, $10,000; for the said college, for labor fund and extra instruction, $10,000; for travelling and other necessary expenses of the trustees of the said college, $800; to defray expenses of collecting and analyzing samples of concentrated commercial feed stuffs, $1,200; and for maintenance of the veterinary laboratory at the said college, $1,000. The Legislature also appropriated for the said college the sum of $10,000 to provide the theoretical and practical education required by its charter and the law of the United States relating thereto; also $200,000 for carrying forward the work against the gypsy and brown-tail moths.

Legislation.

The legislation of 1899 having reference to the Board of Agriculture or to the agricultural societies was "An act making appropriations for sundry agricultural expenses" (Acts of 1899, chapter 46); "An act making an appropriation for continuing the work of exterminating the gypsy moth and the brown-tail moth" (Acts of 1899, chapters 80 and 268); and "An act relative to the inspection of milk" (Acts of 1899, chapter 169).

Would it not be well there should be a special committee appointed to have charge of rules and laws, to recommend or advocate such changes as the Board desires?

Abandoned Farms.

Very little work along this line has been done the past year, and the last edition of the catalogue, issued two years ago, is exhausted. Frequent requests for catalogues and information are received both in person and by letter; and, while the value of this kind of work may be questioned, the fact that there is a demand for this information cannot be overlooked or ignored. One hundred and six requests for the catalogue were received by mail between Aug. 20, 1899, and Jan. 10, 1900, while a large number of applications were made in person at the office.

The work already done has directed attention to this office as a source of help and information to those desiring to sell such farms as may properly come under the title "partially abandoned," and to those desiring information concerning such properties. A small annual appropriation for the carrying on of this line of work, with authority granted this office to serve as a bureau of information, would be of great assistance to those desiring to purchase or sell farms within our borders, with a large resultant benefit to the State.

Dairy Bureau.

The annual report of the Dairy Bureau to the Legislature will be found printed on pages 389–415 of this volume. There has been no change in the personnel of the Bureau, except that of the executive officer, caused by the change in the secretaryship of the Board of Agriculture.

Agricultural College.

The report of the examining committee of the Agricultural College will be found printed on pages 224–230 of this volume. The twelfth annual report of the Hatch Experiment Station of the college is by law bound with the report of the secretary of the Board of Agriculture in this volume. Those desiring further details of the college are respectfully referred to the president, Dr. Henry H. Goodell, Amherst, Mass.

Board of Cattle Commissioners.

The annual report of the Board of Cattle Commissioners is by law printed in the annual report of the secretary of the Board of Agriculture, and the report for 1899 will be found printed on pages 419–514 of this volume.

Massachusetts Crop Reports.

The publication of monthly crop reports or bulletins was continued in 1899, and six in all were issued (May–October), aggregating 230 pages of printed matter. The edition was 2,500 copies, excepting Nos. 1 and 3, of which 2,700 copies were printed.

The special articles printed were: Bulletin No. 1, "Spraying of crops for profit," by Prof. S. T. Maynard; Bulletin

No. 2, "Suggestions for the use of barnyard manure," by Prof. Chas. Wellington; Bulletin No. 3, "The elm-leaf beetle in Massachusetts," by A. H. Kirkland, M.S.; Bulletin No. 4, "Practical hints for the dairyman," by Prof. F. S. Cooley; Bulletin No. 5, "Birds as destroyers of hairy caterpillars," by E. H. Forbush; and Bulletin No. 6, "Nursery inspection," printed by request of the Hatch Experiment Station of the Massachusetts Agricultural College, and "Farmers, prepare for the twelfth census," printed by request of the United States census office. In this last issue was included an "index," covering the crop reports issued in the years 1896–99, inclusive, prepared for the benefit of those desiring to preserve a file of the reports. Some of these special articles will be found printed on pages 261–337 of this volume.

Agricultural Directory.

A directory of the agricultural organizations in the Commonwealth, with officers for 1900, will be found printed on pages 559–574 of this volume.

Library.

The past year has witnessed the completion and publication of the catalogue of the library of the Board, as authorized at the last annual meeting. Five hundred copies were printed, but, as the appropriation was limited, but one hundred copies were bound. It is suggested that the remaining four hundred copies be bound for distribution. Attention is called to the report of the librarian, which will be found printed on pages 236 and 237 of this volume.

A summary of Massachusetts crop conditions and weather for 1899 is here appended.

J. W. STOCKWELL,
Secretary of the State Board of Agriculture.

Boston, January, 1900.

Summary of Crop Conditions. 1899.

The spring of 1899 opened later than usual. Cold nights and dry weather held vegetation in check and interfered with the germination of seeds. Mowings suffered from lack of rain, and feed in pastures was thin and backward. Fall seeding was somewhat winter-killed. The fruit bloom was much below the normal, and many peach trees were killed by the severe winter. Very little damage from insects was reported. Spraying was reported as increasing, but not rapidly. A considerable portion of farm help was classed as good. Wages averaged about $18 per month with board, and about $1.25 per day without. No marked changes were reported in the acreage of farm crops.

In June there was little or no injury from insects. Indian corn generally grew very well considering the drought, with acreage about as usual. Haying was commencing, with a very light crop in all sections. Of early potatoes there was an increased acreage, and a fair prospect for the crop. Early market-garden crops were much shortened in yield by drought, with generally increased prices. The supply of dairy products ran about as usual, with prices the same. Pastures had suffered severely from drought and were in poor shape. Strawberries were not over half a crop, with prices much better than last year. Apples did not set well and were dropping badly. Cherries did well.

July showed a minimum amount of damage from insects. Indian corn made rapid growth and generally promised a good crop. Silos continuing to gain in use. Haying was practically completed, with from one-half to two-thirds of a crop ; quality and condition generally first class. The shortage of the hay crop induced a considerable increase in the acreage devoted to forage crops, and they were generally in good condition. Market-garden crops were nearly up to the normal, with prices a little above recent years. Early

potatoes were dug in many sections, with only a fair crop. Prices ruled high. Rye, oats and barley were below the normal, particularly as to straw.

At the end of August Indian corn was generally in fine condition, though somewhat backward. Rowen was a light crop in all sections, and nearly a failure in the eastern part of the State. Late potatoes looked well and promised a good crop. Very little potato rot was reported, and blight was not general. Barring a little unevenness, tobacco was generally in good condition, and cutting was practically completed at the end of the month. Pasturage was quite short in all except extreme western sections. Oats and barley were considerably below the normal, both as to grain and straw. Poultry keeping was generally considered profitable, but is a side issue save in the south-eastern counties.

September showed Indian corn to be a full average crop. The rowen crop was much below the average, and in many sections was an entire failure. Fall feed was also sadly off in condition. Less than the usual amount of fall seeding had been done, owing to dry weather, and that put in was generally below average in condition. Onions were considerably above an average crop on the whole, particularly in the Connecticut valley. Late potatoes were an exceptional crop in almost all sections, both in yield and quality. Root crops somewhat in need of rain. Celery was apparently a good average crop. Other late market-garden crops were doing fairly well. Apples were a very poor crop, except in a few localities. Pears not half a crop, plums even less, and peaches a failure. Cranberries were rather more than an average crop, of good quality. Grapes were generally abundant, and mostly secured without injury from frost.

Correspondents the last of October reported root crops in good condition, and potatoes an unusually heavy crop of excellent quality. Celery was a good average crop. There was considerable complaint that farm stock was poor in flesh, because of poor pastures, but otherwise it was generally in good condition. Many farmers had been obliged to feed at the barn for a month or more. Considerably

less than the usual amount of fall seeding done, because of dry weather, and that done was below average in condition.

Prices received for farm crops, taken as a whole, appeared to show quite a general improvement over former years, due in part perhaps to shortage in particular crops. Out of 147 answers to the question as to prices, 84 correspondents spoke of prices as average, 48 as higher than usual and 15 as lower.

There was the usual diversity of opinion among correspondents as to which crops had proved most profitable. Sixty-nine considered potatoes to have been among the most profitable crops; 42, corn; 36, hay; 16, apples; 12, tobacco; 9, cranberries; 8, sweet corn; etc. Twenty-five correspondents spoke of hay as among the least profitable crops; 22, apples; 22, potatoes; 13, onions; 12, squashes; 9, corn; 8, fruit; 6, oats; 6, milk; 6, tomatoes; 6, peas; etc. Taking into consideration both the results obtained from a classification of the returns and the general tone of the returns themselves, it is considered that the past year was a more than usually prosperous one for our farmers. Almost all crops made at least good average yields, and where there was any shortage it was usually compensated for by increased price received. Most farmers had a surplusage of hay on hand at the beginning of the season, so that the light hay crop will not be as severely felt as would otherwise have been the case. Of 138 correspondents answering the question as to the profits of the season, 91 regarded the season as profitable, 29 as an average one for profit and 23 as fairly profitable, while 29 thought that it had not been a profitable one.

Massachusetts Weather, 1899.

[Compiled from data furnished by the New England Weather Service.]

January was a month without marked departures from normal conditions, the small amount of snowfall being the chief abnormal condition. The temperature for the month was very slightly in excess of the normal. The monthly average of precipitation was only slightly below the normal, the loss of moisture from the small amount of snow being counterbalanced by an excess of rainfall.

The first half of February was uninterruptedly cold and the second half uniformly mild, the mean monthly temperature being about 2° below the normal. The precipitation of the month was practically normal. A typical "coast storm," with violent gales, occurred on the 12th and 14th. Railroad traffic was considerably interfered with, but the loss of life at sea was comparatively small.

March was conspicuous for much unpleasant weather, cloudiness and precipitation being almost constant. An ice storm of wide-spread area occurred on the 19th, doing considerable damage to trees and telegraph poles. The temperature for the month averaged about 1° below the normal, and at its close the season was backward in all sections.

April was remarkable for the large number of clear and fair days, there being but six stormy days during the month. The early part of the month averaged cool and the closing days were unusually warm. The average temperature of the month was very near the normal, but there was a marked deficiency in precipitation. Preliminary spring work made excellent progress.

May was remarkably deficient in precipitation; for, while the number of days with a measurable amount of precipitation averaged about as usual, there was no good, soaking rain. As the result, the precipitation was the smallest since the establishment of the Weather Service in 1870. The temperature averaged about 1° per day above the normal. The coolest period of the month was from the 17th to the 23d, when frosts were prevalent in exposed localities. An abundance of sunshine was a feature of the month. Crop prospects were much impaired by the continued drought of April and May.

The first part of June gave extreme heat and absence of precipitation, less than .9 inch falling at Boston, as against a normal of about 1.75 inches. The temperature of the month was decidedly above the normal, the average daily departure being about 5° plus. The drought was broken during the latter part of the month by severe thunder storms with excessive precipitation, but any damage to fruit and "washing" of fields was more than compensated for by their beneficial effects. Much damage was done to fruit and glass

in the western part of the State by a severe hail storm on the 24th.

General showers occurred in the first week in July, which effectually broke the drought that existed through May and June. These conditions continued until the 18th of the month, but from the 18th to the 25th the showery weather was confined to the western sections of the State. At the end of this period a second drought was complained of in eastern sections, which was, however, relieved by copious showers on the 25th and 26th. The temperature averaged somewhat above the normal, but was generally devoid of extremes. July did much to repair the damage resulting from the dry weather of the two preceding months.

August opened with several days of generally fair weather in all sections, and seasonable temperatures. By the close of the first week the dry weather was seriously felt in the eastern counties, but copious showers occurred in these sections on the 10th and 11th. During the third week of the month there was little or no precipitation, and that of the 22d was principally in the eastern counties, where the drought was most severe. A notable feature of the month was an absence of the usual muggy, oppressive conditions. The weather was somewhat cool from the 7th to the 14th, and unseasonably so at coast stations during the closing week of the month.

September opened with showers on the 1st and 2d, which were of general occurrence and great benefit. The second week of the month was fair, with much sunshine, but with a sharp falling off of temperature, which had ranged about normal the preceding week. The temperature of the third week was several degrees cooler than the normal of the season. General rains fell on the 20th and 21st of the month; these rains were copious, and of great benefit to pastures and meadows. With the rain came warmer weather, and nearly average temperature conditions prevailed in the last week of the month. As a whole, the month was exceptionally fine and pleasant.

The month of October opened with a cold wave of unusual severity for the season, with snow flurries in many sections. The temperature ranged below normal from the

1st to the 9th inclusive, excepting the 5th, which was somewhat warmer than the average. The minimum range of the mercury at Boston on the 2d and 3d, 34° and 35° respectively, broke the official record, being the lowest for those days of the month of October in twenty-seven years. A "warm spell" prevailed from the 10th to the 19th inclusive. There was a general deficiency in the precipitation for the month, the rainfall being little more than half the customary amount for October. Owing to the prevalence of dry weather, there was much haze, smoke and dust in the atmosphere, giving conditions usually descriptive of the period commonly known by the name of Indian summer.

November was marked by a preponderance of fair weather, precipitation occurring in measurable amounts on an average of but six days. The precipitation was deficient at all stations where official observations were taken. As gauged by popular opinion, the month was unusually warm, which conclusion was doubtless due to the equable distribution of the temperature throughout the period. An examination of the temperature data, however, disproves the opinion, and shows that the monthly mean was less than half of a degree in excess of the normal for November. As a result of the dry weather and small rainfall, wells, springs, streams, ponds and lakes were low.

The weather during December deviated greatly from the types usually experienced during this month in New England. It was unusually warm from the 1st to the 25th, Christmas Day inclusive, during which time plowing and grading progressed almost uninterruptedly in many sections of the State. In many localities of the eastern counties grass remained green till near the close of the month, wild and cultivated flowers were in bloom in the open air, and there was little if any frost in the ground. The closing days were cold, being marked by a well-defined cold wave. This month, like November, was also very dry. The precipitation was 1.80 inches less than the normal, and was chiefly in the form of rain, and in some localities there was an entire absence of snow. The drought caused a continuation of inconveniences to farms and to manufactures.

Meteorological Observatory of the Hatch Experiment Station (Massachusetts Agricultural College), Amherst.

Annual Summary for 1899.

Pressure (in Inches).

Maximum reduced to freezing, 30.57, January 2, 9 A.M.
Minimum reduced to freezing, 28.79, December 24, 8 P.M.
Maximum reduced to freezing and sea level, 30.92, January 2, 9 A.M.
Minimum reduced to freezing and sea level, 29.10, December 24, 8 P.M.
Mean reduced to freezing and sea level, 30.011.
Annual range, 1.82.

*Air Temperature (in Degrees F.).**

Highest, 93.0, June 5, 3 P.M.
Lowest, —21.5, January 2, 6 A.M.
Mean, 46.8.
Mean of means of max. and min., 47.2.
Mean sensible (wet bulb), 43.7.
Annual range, 114.5.
Highest mean daily, 81.5, June 6.
Lowest mean daily, —0.5, February 11.
Mean maximum, 57.8.
Mean minimum, 36.6.
Mean daily range, 21.2.
Greatest daily range, 47.0, April 29.
Least daily range, 4.5, March 15, November 15, December 5.

Humidity.

Mean dew point, 40.1.
Mean force of vapor, .420.
Mean relative humidity, 75.6.

Wind.—Prevailing Direction West, Southwest. Summary (Per Cent).

North, 18.
North-west, 15.
South-south-west, 12.
South-west, 11.
South, 10.
West, 10.
Other directions, 24.
Total movement, 47,110 miles.
Greatest daily movement, 449 miles, February 13.
Least daily movement, 4 miles, December 18.
Mean daily movement, 129 miles.
Mean hourly velocity, 5.2 miles.
Maximum pressure, per square foot, 22 pounds = 66 miles per hour, March 7, 12 M., N.E.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 41.49.
Number of days on which .01 or more rain or melted snow fell, 110.
Snow total, in inches, 52.

Weather.

Mean cloudiness observed, 54 per cent.
Total cloudiness recorded by sun thermometer, 2,210 hours = 50 per cent.
Number of clear days, 81.
Number of fair days, 139.
Number of cloudy days, 135.

Bright Sunshine.

Number of hours recorded, 2,245 = 50 per cent.

Dates of Frosts.

Last, May 4.
First, September 14.

Dates of Snow.

Last, April 16.
First, November 12.
Total days of sleighing, 51.

Gales of 50 or More Miles per Hour.

January 7, 52 miles, N.W.; January 15, 60 miles, N.W.; January 27, 64 miles, N.W.; February 10, 51 miles, W.; February 13, 55 miles, N.; March 7, 66 miles, N.E.; March 20, 62 miles, N.; March 29, 61 miles, N.W.; March 30, 53 miles, W.; December 12, 56 miles, S.W.

J. E. Ostrander, *Meteorologist.*
A. A. Monahan, *Observer.*

* Temperature in ground shelter.

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE,

1899.

MEETINGS OF THE EXECUTIVE COMMITTEE,

ACTING FOR THE BOARD.

BOSTON, Feb. 14, 1899.

The executive committee was called to meet this day, but, on account of the unusual blockade of roads and railroads by snow, a quorum of the committee was not present. Messrs. Appleton and Sessions, being present, adjourned the meeting to February 21.

BOSTON, Feb. 21, 1899.

The adjourned meeting was held in part to consider the request of the Weymouth Agricultural and Industrial Society for the approval by the Board of Agriculture of the vote passed at a special meeting of the said society, on Jan. 9, 1899, "That the treasurer of the Weymouth Agricultural and Industrial Society be, and he hereby is, authorized to negotiate, execute and acknowledge a mortgage and mortgage note, in the name of said society, and transact any other conditions necessary for placing a mortgage on the real estate of said society; said mortgage to be for a sum not exceeding $3,000, to run not less than three years or more than five years, at a rate of interest not to exceed 6 per cent." There was presented a statement of the secretary of the society, giving a copy of the vote above quoted; a statement that the special meeting was legally called for the purpose of voting on this matter; that the affirmative vote was unanimous; and that there was a quorum present. It was also shown that the hearing on the matter was advertised as required by the notice of the secretary of the Board of Agriculture.

No person appearing in opposition, it was

Voted, To approve for the Board of Agriculture the above-quoted vote of the Weymouth Agricultural and Industrial

Society, in accordance with the provisions of chapter 274 of the Acts of 1890.

Voted, That the secretary be instructed to notify the secretary of the Weymouth Agricultural and Industrial Society of the action of the Board.

There was also presented the request of the Worcester North-west Agricultural and Mechanical Society for the approval by the Board of Agriculture of the vote of the said society, passed at a special meeting of the society, Jan. 27, 1899, "That the treasurer of the Worcester North-west Agricultural and Mechanical Society be and hereby is authorized and instructed to borrow the sum of $3,500, and give the note of the society therefor, and secure payment of the same by a good and sufficient mortgage of all the real estate owned by the society, and is hereby empowered to execute said mortgage in the name of, and for, said society, and with the money thus borrowed to immediately pay that amount of the present indebtedness of said society."

There was presented a statement of the secretary of the society, giving a certified copy of the vote above quoted; a statement that the special meeting was legally called for the purpose of voting on this matter; that the affirmative vote was unanimous; and that a quorum was present. It was also shown that the hearing on the matter was advertised as required by the notice of the secretary of the Board of Agriculture.

No person appearing in opposition, it was

Voted, To approve for the Board of Agriculture the above-quoted vote of the Worcester North-west Agricultural and Mechanical Society, in accordance with the provisions of chapter 274 of the Acts of 1890.

Voted, That the secretary be instructed to notify the secretary of the Worcester North-west Agricultural and Mechanical Society of the action of the Board.

The credential of Mr. Francis H. Appleton of Manchester, appointed by His Excellency, February 1, to fill the vacancy on the Board of Agriculture occasioned by the death of Mr. S. S. Stetson of Lakeville, was presented and approved.

The credential of Mr. J. M. Danforth of Lynnfield, as delegate to the Board of Agriculture, elected by the Essex Agricultural Society to fill the vacancy caused by the resignation of Mr. Francis H. Appleton, was presented. A protest by one of the trustees of the said society against the acceptance of the said credential, on the ground that the meeting at which Mr. Danforth was elected was not a legal meeting, being received, it was

Voted, In view of said protest, that the matter of the acceptance of the said credential and the protest lie on the table to await further information, and that the secretary be instructed to communicate the facts in the case to the secretary of the Essex Agricultural Society, the member-elect, with a copy of the protest, and to the protestor, with request to each for further information on the matter.

The matter of delinquencies of several agricultural societies, in furnishing financial returns, premium returns and transactions, as required by law and the rules of the Board, referred to the executive committee at the annual meeting, with power to excuse such delinquencies if in the judgment of the committee it seemed best to do so after investigation, being in order, the several cases were investigated, and, the excuses offered being considered sufficient, it was

Voted, To excuse the Berkshire and Housatonic societies for delay in sending financial returns; also the Amesbury and Salisbury, Berkshire and Housatonic societies for delay in sending premium returns; also the Barnstable County, Franklin County, Highland and Spencer societies for delay in sending copies of the transactions.

Voted, That the secretary be instructed to notify the societies interested of the action of the executive committee.

BOSTON, April 3, 1899.

This day the executive committee authorized the Hoosac Valley Agricultural Society to begin its fair this year on the third Tuesday after the first Monday in September, instead of on the third Wednesday, as heretofore.

BOSTON, Sept. 5, 1899.

The meeting was called in part to consider the request of the Worcester Agricultural Society for change of date for the holding of its 1899 fair.

Voted, That the request of the Worcester Agricultural Society for a change of date of its annual fair from Sept. 5, 6 and 7 to Sept. 21, 1899, be approved.

Voted, That the secretary be instructed to inform the secretary of the Worcester Agricultural Society of the action of the Board.

The credential of Mr. Alfred C. Stoddard, elected by the Spencer Farmers' and Mechanics' Association as a member of the Board of Agriculture, to fill the vacancy caused by the resignation of Mr. J. Elton Green, was presented. The question of the legality of the election being raised, and it appearing that Mr. Stoddard was elected at a meeting of the trustees of the society, and it not appearing that this was their customary manner of electing the delegate to the Board of Agriculture, it was

Voted, That the secretary be instructed to inform the Spencer Farmers' and Mechanics' Association of the apparent legal difficulties that have arisen, and inform it that, if it will send a credential certifying that Alfred C. Stoddard has been elected delegate to the State Board of Agriculture in the usual manner, the committee will receive and consider the credential, and that in the mean time the original credential be laid on the table.

The matter of the request to His Excellency of the manager of the Mid-Continental Agricultural Exhibition and Harvest Festival, to be held in Cincinnati September 25–October 7, to appoint delegates to the national agricultural congress, to be held in connection with the exhibition, being in order, it was

Voted, That the matter be referred to the secretary, with full power to act.

The question whether the members of the Board are entitled to compensation for their travelling and necessary

expenses in attending the Farmers' National Congress, they being, by appointment of His Excellency, associate delegates to the said Congress, being brought up, it was

Voted, That there be a special meeting of the Board of Agriculture at Boston on Oct. 4 and 5, 1899, in connection with the Farmers' National Congress.

Voted, That the thanks of the Massachusetts Board of Agriculture be extended to the Hon. John E. Russell for the excellent portrait of himself which he has so kindly donated to said Board, and which now hangs on the walls of the private office of the secretary; and that the secretary be instructed to inform him of this action.

SPECIAL MEETINGS

OF THE

BOARD OF AGRICULTURE,

1899.

SPECIAL MEETINGS OF THE BOARD OF AGRICULTURE.

BOSTON, March 28, 1899.

The Board of Agriculture met in the office of the Board, in Boston, this day, at 1 P.M., for business.

Present: Second Vice-President E. W. Wood, who presided, and Messrs. F. H. Appleton, Baker, Barrus, Barton, Bowditch, Bursley, Clark, Damon, Ellsworth, Gleason, Goodell, Hersey, Horton, Howard, Kilbourn, Pratt, Reed, Richardson, Sargent, Sessions, Stockwell, Thayer, Thurston and E. E. Wood.

The executive committee, as committee on credentials, reported that Mr. John M. Danforth of Lynnfield had been elected by the Essex Agricultural Society, to fill the vacancy caused by the resignation of Mr. Francis H. Appleton. The report of the committee was accepted, and Mr. Danforth was duly received as a member of the Board of Agriculture.

The request of the Worcester Agricultural Society for the approval by the Board of Agriculture of the vote of the said society, passed at a special meeting of the society, on March 10, 1899, that a special committee be "authorized to sell the real estate belonging to the Worcester Agricultural Society for the sum of $185,000 or as much more as can be obtained, etc.," being in order, the matter was considered.

The secretary of the society presented the records, showing that the special meeting on March 10 was legally called for the purpose of authorizing the sale of the real estate of the society; that a quorum of members was present; and that the vote authorizing the sale was carried by affirmative vote of two-thirds of the members present and voting. It was also shown that the hearing had been advertised according to the directions given by the secretary of the Board of Agriculture. After remarks by the president and delegate of the

society, and discussion, and no person appearing to object to the sale of the real estate, it was

Voted, That, whereas the officers of the Worcester Agricultural Society have expressed their intention to use the proceeds of the sale of the society's grounds for the purposes for which the society was incorporated, the Massachusetts State Board of Agriculture hereby approves the vote of the Worcester Agricultural Society, passed at a special meeting, on March 10, 1899, "That Henry S. Pratt, William A. Gile, Edwin P. Curtis, Calvin L. Hartshorn, Francis A. Harrington and Frederick H. Chamberlain, all of Worcester, and Ledyard Bill of Paxton, or a majority of them, be authorized to sell all the real estate belonging to the Worcester Agricultural Society for the sum of $185,000, or for as much more as can be obtained. A majority of said persons are hereby given full and complete authority to determine the terms, conditions and manner of sale, conveyance and payment of and for said real estate, and to do any and all things necessary to carry out and complete said sale, conveyance and payment, including executing, acknowledging and delivering all necessary deeds, written instruments and papers in the name of said society. The said agents of the society may take as part payment for said real estate a mortgage of the same to the society, for such an amount, in such form and on such terms as a majority of them may deem expedient," in accordance with the requirements of chapter 274 of the Acts of 1890.

Voted, That the secretary be instructed to notify the secretary of the Worcester Agricultural Society of the action of the Board.

On motion of General Appleton, it was

Voted, That the Board of Agriculture assembled in special meeting expresses to the Worcester Agricultural Society its appreciation of all that said society has done in the past to promote the cause of Massachusetts agriculture and the interest of our agriculturists, and extends to it all encouragement for the society's future efforts in that direction.

The request of the Plymouth County Agricultural Society for the approval by the Board of Agriculture of the vote of

the said society, passed at its last annual meeting, on Dec. 20, 1898, "That a committee of three be chosen to sell the real estate of the society, subject to the approval of the trustees," being in order, the matter was considered.

The secretary of the society presented the records, showing that the annual meeting was legally called for the purpose of authorizing the sale of the real estate of the society, and that the vote authorizing the sale was passed unanimously. It was also shown that the hearing had been advertised according to directions given by the secretary of the Board of Agriculture. After remarks by the delegate of the society, and discussion, and no person appearing to object to the sale of the real estate, it was

Voted, That, whereas the officers of the Plymouth County Agricultural Society have expressed their intention to devote the proceeds of the sale of the society's grounds for the purposes for which the society was incorporated, the Massachusetts State Board of Agriculture hereby approves the vote of the Plymouth County Agricultural Society, passed at the annual meeting, held Dec. 20, 1898, "That a committee of three be chosen to sell the real estate of the society, subject to the approval of the trustees," in accordance with the requirements of chapter 274 of the Acts of 1890.

Voted, That the secretary be instructed to notify the secretary of the Plymouth County Agricultural Society of the action of the Board.

There being a vacancy in the committee on gypsy moth, insects and birds, the Chair appointed Mr. John M. Danforth of Lynnfield to fill the vacancy, which appointment was approved by vote of the Board.

On motion of Mr. Barton, it was

Voted, That the gypsy moth committee of this Board invite the members of Congress from Massachusetts to visit the infested district, and witness the work of the committee in the extermination of the gypsy moth.

On motion of Mr. Barrus, it was

Voted, That it be left to the gypsy moth committee to press the necessity of an appropriation from the United

States Congress, and that the members of the Board personally exert themselves to interest their Congressmen to visit the infested territory.

Adjourned.

Boston, Oct. 4, 1899.

By vote of the executive committee, a special meeting of the Board of Agriculture was called at Boston, October 4 and 5, in order that the members might receive compensation for their travelling and necessary expenses in attending the meeting of the Farmers' National Congress, they being by appointment of His Excellency associate delegates to the said Congress.

Westfield, Dec. 5, 1899.

The Board of Agriculture met in Columbia Hall, Westfield, this day, at 10.30 a.m., for business.

Present: Second Vice-President E. W. Wood, who presided, and Messrs. Allen, F. H. Appleton, J. S. Appleton, Baker, Barrus, Barton, Benedict, Bowditch, Bursley, Clark, Damon, Danforth, Ellsworth, Hall, Hersey, Horton, Howard, Kilbourn, Lloyd, Pratt, Reed, Richardson, Sargent, Smith, Stockwell, Thayer, Thurston and Whitmore.

The secretary presented and read the report of the gypsy moth committee to the Legislature.

The Chairman. You have heard the report of your committee. It is now in the hands of the Board. What will you do with it?

Mr. W. B. Barton (of Dalton). I move that it be accepted and adopted.

Prof. C. H. Fernald (of Amherst). Mr. President, ladies and gentlemen: I firmly believe, if the money the committee has asked for from year to year had been promptly granted, the gypsy moth would to-day be entirely exterminated. That is not a guess; it is the result of a careful examination and study of the whole question. Since it has not been done, we have to meet the problem where

we find it. Allusion has been made to the estimate I made several years ago about the time and amount of money required to exterminate the moth. For two years past we have received the sum indicated in that estimate, lacking $10,000. Such substantial progress has been made that it seems to confirm the opinion that I have expressed. So strongly does it seem to confirm that, that I feel like presenting it again, — that, if the Legislature will appropriate the money for the time indicated, it will bring about the desired result, if managed as it has been by your committee in the past. I made the estimate after a careful study of the territory and of the work for a number of years, and of the insect, and have asked for the opinion of another man, Dr. L. O. Howard, who has been referred to. I wrote him last winter, during the session of the Legislature, to find out what he thought of that estimate. He wrote me in reply a letter which has not been published, and which I think will appear in my report. I was very glad to have an outside man, a man who stands as high in entomology as he does, and who has no personal interest in the matter other than the wish that extermination might be accomplished, give that opinion, agreeing with mine. Dr. Howard, as many of you well know, has been sent here from year to year by the general government to inspect this work. No entomologist has spent so much time in the territory, going over the entire work, as Dr. Howard has; and he has given his opinion from year to year, first in the form of a bulletin published by the Department of Agriculture at Washington, and this fall he visited the work, and has written me in reply to my question as to his impressions of the work this fall. We have in these letters the opinion of the man who stands highest in economic entomology in this country, and when we say that, we can say of the whole world.

There is nothing touches a man any more closely than dollars and cents. The question comes in here, Will it pay? How much will it cost a farmer in the extreme western part of the State, who is least of all likely to be affected by the moth, it will be so long before it reaches him? An appropriation of $200,000 is less than $\frac{1}{12}$ of a mill on a dollar. If a man is taxed for $5,000 worth of property, his portion

of that $200,000 will be 41 cents and 6 mills. Suppose a young man should take a farm when twenty-one years of age, and stay until he is sixty-one. If that tax went on during that time, the sum total for the forty years would be about $16. You cannot clear a single tall elm, unaided, for that sum of money; if you can, you can do better than I. You cannot go through a row of ordinary apple trees and clear the gypsy moth from it for $16, and clear it thoroughly. You are simply paying a premium to the State to protect you from this insect. You pay some insurance company a larger premium than that to protect your buildings from fire.

Are you willing to allow this insect to come over into this beautiful territory and devastate this valley, and you have to fight it yourselves, when the State can do it so much better and cheaper than you can do it? If, on the other hand, the State will exterminate the insect, as the Board of Agriculture is working to have it do, how much better that will be. I believe this is a matter that you should consider yourselves, individually. Is it cheaper for you to pay a tax and have the insect exterminated, or let it go and you fight it yourselves?

Mr. N. B. Baker (of Savoy). When I came on the Board there was no one more skeptical in regard to the gypsy moth. I live in a town in the north-western part of the State, in a place where we have never been troubled with the gypsy moth. I went onto the infested grounds with the committee and some of the members of the Board three years ago this coming winter, and I saw the men at work. I became much interested, because I knew when I went back home the people would question me in regard to the gypsy moth. I saw what the men were doing. I thought they ought to cut the woods down and burn them up. It seemed to me that that would wind up the whole business. They told me that the owners did not want the trees cut, and they had to use other methods. I tell you I have become converted in regard to this gypsy moth matter. I know that pest as I have seen it in Malden. No better class of men ever worked for the State than the men employed by the Board of Agriculture. There wasn't any "funny" work. The roll was called in the morning, and they went to work

and worked for business. Some of the men are not choppers, but they are a good class of men.

Mr. Augustus Pratt (of North Middleborough). It was suggested to the gypsy moth committee last evening, and it met my views, that more information in regard to this pest be sent out throughout our Commonwealth at our farmers' institutes. Probably many of the agricultural societies represented here will hold institutes early in the season. It seems to me there is a great lack of information throughout the Commonwealth in regard to the work, and in regard to this dangerous pest if it is allowed to escape. The suggestion is made that, at these farmers' institutes, held early in the season, speakers provided by the Board present this subject. I suggest that it would be advisable for the Board of Agriculture to recommend that this matter be brought before the societies early in the season.

Mr. C. E. Parker (of Holden). I would like to emphasize one point in this report that says that Congress should take hold and do this work. We need not only to have information distributed throughout the Commonwealth, but that every member of this Board should make a personal application to the Senators of Massachusetts and the Representatives in Congress to take hold of this work with Massachusetts. What is everybody's business is no one's. It seems to me the matter should be brought to the attention of Congress. Now that the Spanish war is off our hands, it seems to me that something can be done. I believe Massachusetts ought not to go on with this work alone. When I was in the Legislature, my opinion was that Massachusetts would not always go on paying $200,000 a year. I believe Congress should take hold of the matter. I think some measures to bring that about ought to be taken.

Secretary Stockwell. Measures have been taken, and the Congressmen have been on the grounds. We have not time to discuss this now, without taking the time belonging to the lecturer of the morning.

Voted, unanimously, to accept and adopt the report of the committee.

Voted, That the Board of Agriculture recommends to each of the agricultural societies that at their next farmers' insti-

tute they engage a speaker to present the subject of the gypsy moth to the people.

Voted, To adjourn the business meeting to 9 A.M., Thursday.

WESTFIELD, Dec. 7, 1899.

The adjourned meeting was called to order by Chairman Wood.

The secretary presented the credential of Mr. H. H. Sigourney of Oxford, elected by the Oxford Agricultural Society to fill out the unexpired term of Mr. J. W. Stockwell, resigned.

Voted, That the credential of Mr. Sigourney be accepted, and that he be admitted as a member of the Board.

The secretary presented the credential of Mr. John G. Avery of Spencer, elected by the Spencer Farmers' and Mechanics' Association to fill out the unexpired term of Mr. J. Elton Green, resigned.

Voted, That the credential of Mr. Avery be accepted, and that he be admitted as a member of the Board.

The hearing on the request of the Oxford Agricultural Society for the approval by the Board of Agriculture of the unanimous vote of the society, passed at its annual meeting, to sell a part of its real estate, being in order, the matter was heard. It appearing that the action of the society was according to law and properly advertised, and no person appearing in opposition to the request of the society, it was

Voted, That the Board of Agriculture approves of the vote of the Oxford Agricultural Society, passed at its annual meeting, Nov. 3, 1899, to sell a portion of its real estate, in accordance with the requirements of chapter 274 of the Acts of 1890.

The secretary presented the request of the Berkshire Agricultural Society for the approval by the Board of Agriculture of its vote at a special meeting, duly called for the purpose,

on Nov. 29, 1899, "That the president and treasurer be and hereby are authorized and empowered to borrow the sum of $2,000, or such lesser sum as may seem to them necessary, to be used in meeting the indebtedness of the society, and to sign, execute and deliver, to secure the payment of said sum, a deed of mortgage of the real estate of the society, subject to the mortgages now existing on said real estate." It appearing that the action of the society was according to law and properly advertised, and no person appearing in opposition to the request of the society, it was

Voted, That the Board of Agriculture approves of the vote of the Berkshire Agricultural Society, passed at its special meeting, as above quoted, in accordance with the provisions of chapter 274 of the Acts of 1890.

Secretary STOCKWELL. The matter of the gypsy moth that was brought up at the last meeting is now in order, and I move that the consideration of the matter of its extermination before Congress be deferred to the annual meeting of the Board, at Boston, January 9.

The motion was seconded, and it was so voted.

Secretary STOCKWELL. I have received from the Massachusetts Fish and Game Protective Association a letter, requesting that we appoint one or more delegates to meet their members and representatives of other sportsmen's and farmers' clubs in convention at the Copley Square Hotel, Boston, on Thursday, Dec. 14, 1899. I move that Messrs. Ellsworth of Worcester and Thurston of Swansea be the delegates to this convention.

The motion was seconded, and it was so voted.

The CHAIR. The time for our regular meeting has arrived. Mr. A. M. Lyman of Montague, representing the Massachusetts Forestry Association, has made application, and we have granted his request, to make a short statement in regard to its work.

Mr. LYMAN. Mr. Chairman, ladies and gentlemen, and people of western Massachusetts especially: I have been requested by the executive officers of the Massachusetts For-

estry Association, which is more familiarly known in the eastern part of the State because of the services it has rendered in connection with the gypsy moth work and in other ways, to bring this matter before you. Laws have been passed that provide that tree wardens shall be elected in every town at the annual meeting. We want you to see that the right kind of men are elected to that office. They are to protect especially the shade trees. I am very much interested in this work, myself. I have looked after it for many years. We ought to co-operate with this association. I think it would be a benefit to us to do so.

Mr. Lyman then read the following: The Massachusetts Forestry Association is an institution for our benefit in promoting and protecting our interests in that which is considered so valuable and beautiful in adorning the highways of the whole State. And especially to-day we wish to interest many in western Massachusetts, who hardly realize how near we have come, and may yet, to having our ornamental shade trees destroyed.

Mr. J. G. Avery (of Spencer). As I understand it, these laws are for the protection of shade trees by the roadside. We had a very fine oak tree by the watering trough, and the man who owned it cut it. In hot days people used to rest their horses under the tree. I understand that the prevention of the destruction of trees like that is what is to be looked after.

Mr. M. A. Morse (of Belchertown). I would like to say that, as I understand it, the Forestry Association has nothing to do with woodlands. You have a right to cut your woodlands, outside of the limits of the highway; but you have not, under the new law, a right to cut shade trees within the limits of the highway, without getting permission of the tree warden, if tagged.

Mr. Lyman. Where the woodland comes down to the highway, the trees within the limits of the highway are under the protection of the tree warden, and can be tagged or nailed.

Mr. Smith (of West Springfield). It seems to me that the vital matter has not been touched. If a tree is tagged,

and is attacked by the elm-leaf beetle, for instance, is the tree warden responsible for the damage done by the beetle? Must he protect the trees?

Mr. Morse. I should say no, but I do not like to make a statement when I am not positive.*

Adjourned.

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* The Massachusetts Board of Agriculture, under the provisions of chapter 196 ot the Acts of 1890, as amended by chapter 49 of the Acts of 1891 and chapter 147 of the Acts of 1892, has furnished from the office of the secretary of the Board approximately 220,000 M spikes, with accompanying washers, to the cities and towns within the Commonwealth, since December, 1891. During 1899 M spikes and washers were furnished on request to thirteen towns. The law designates that these spikes shall be procured and furnished by the secretary of the Board of Agriculture to the mayor and aldermen of the cities and the selectmen of the towns, and that the trees so designated shall be "trees within the limits of the highways for the purposes of ornament and shade." It is further stated that "This act shall not apply to ornamental or shade trees whose preservation is now provided for by chapter fifty-four of the Public Statutes and the acts amendatory thereof."

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

WESTFIELD.

DECEMBER 5, 6 AND 7, 1899.

PUBLIC WINTER MEETING OF THE BOARD,

AT WESTFIELD.

The annual public winter meeting of the Board was held in Columbia Hall, Westfield, on Tuesday, Wednesday and Thursday, December 5, 6 and 7. The weather conditions were extremely favorable, and the meeting was a successful one.

The opening session was called to order by Secretary Stockwell, who said: It is fitting and proper and according to our usual custom that we look to the Divine Master for guidance and aid in the work and discussions of this meeting. I will call upon the Rev. R. B. Esten to offer prayer.

Prayer by Rev. Mr. Esten.

Secretary Stockwell. We come to this beautiful town at the request of its people, to hold this our annual winter meeting. We will first listen to an address of greeting by the chairman of the Board of Selectmen, Mr. Chas. H. Beals.

Mr. Beals. It is with a great deal of pleasure that we welcome you to our town. We trust that your visit with us will be pleasant and beneficial. Like all towns in this northern latitude, our town is not at its best. Our lawns and streets are our pride in the summer. Our factories are all busy; our people are well employed. We invite you to go through our mills and factories. This town is the centre for whip manufacturing. More whips are made here than in any other town in the world. We manufacture three-fourths of the whips used in this country, most of them being sold and used in this country.

We feel very proud of our schools, and we invite you to visit them. We have in our town the State Normal School. We think there is none better in the State. If you have daughters who wish to fit themselves for teachers, they cannot do better than to come to our normal school.

We hope your visit will be so pleasant that you will want to come again. We hope that you will have a good time, and that it will be beneficial to all.

Secretary Stockwell. Mr. E. W. Wood, second vice-president of this Board, will respond to the address of welcome by Mr. Beals, and will hereafter have charge of these meetings as the presiding officer.

Mr. Wood. I desire to express, in behalf of the members of the Board, our thanks to the gentleman who has preceded me for this cordial welcome.

It has been the practice of the State Board of Agriculture, since 1863, to hold, in some part of the Commonwealth, what we term a "winter meeting." The management of these meetings and the place of holding them are decided at the annual meeting held in January, After the decision of the location, a committee consisting of the delegates living nearest the location is appointed to make the arrangements for the meeting. These meetings have been held in this form since 1863. The work of the committee has been to make all preparations for the meeting, by selecting the topics, and these have been selected with a view to the location where the meeting is to be held. Such topics as will interest the majority of farmers in the vicinity are selected. The committee also procures the speakers to address the meeting. The object in securing speakers has been to get men who, either from practical experience or scientific knowledge or both combined, are competent to give instruction on the themes they discuss, which will be of practical value to the farmers throughout the State.

In coming to Westfield, our farmers understand that they come to a part of the State most favorably located for agricultural interests. Our farmers who come from the eastern part of the State, where portions of the soil are so encumbered with rocks and boulders as to be cultivated with great difficulty, and where other portions of the soil are so shallow and light that a crop almost entirely depends on the fertilizer applied, — when they come to look into the Connecticut valley, where they see the wide, level fields, where the plough is not disturbed by a stone, where you need to use but a small quantity of fertilizer, it is rather discouraging to

them. They look upon you as having your fields laid in pleasant places. The husbandman who looks over this western portion of the State can hardly refrain from a feeling of envy as he sees the ideal places for orchards, especially for that most important New England fruit, the apple, which is every year coming to hold a more and more important place in the balance sheet of the farmer at the close of the year.

The interests in and benefits from this meeting depend very largely upon the local farmers and others interested in agriculture; and, from our experience in this immediate vicinity, where some of the largest meetings of the Board have been held, we have every reason to believe that this meeting will be no exception, — that there will be a good attendance, and that the speakers who have been requested to give lectures during the meeting will be able to interest the farmers and others who may attend, and that the meeting will not only prove interesting but beneficial to the agriculture of the State.

We will now listen to an address of welcome by Mr. H. K. Herrick, president of the Union Agricultural and Horticultural Society of Blandford.

Mr. Herrick. I am very happy to meet with you and welcome you here. It gives me pleasure to do so as a representative of the Union Agricultural and Horticultural Society. And yet I have regrets, because I am trying to fill a position assigned to another, as you will see by the programme. Mr. C. M. Blair looked forward to this meeting with pleasure, but on account of illness he is unable to be here. You may rest assured his mind and heart are with you.

The Union Society which I represent is a thrifty one. It has a membership of over twelve hundred. Its fair grounds are situated upon the hill-top, from which views can be had for miles in any direction. Its light cannot be hid, if it would.

The soil of that section is adapted mainly to hay and grass, corn, potatoes and fruit. From the hay and grass are raised some of the finest steers and oxen, with nearly all of the leading breeds of cows. An inspection of the secretary's entry books would have shown a list for premiums of over five hundred head of neat stock at the last annual fair.

Twenty-five years ago the State Board of Agriculture had its public winter meeting at Westfield. It was my first experience at these meetings, and I verily believe it was a source of some good to me. I hope this meeting may be an influence for good to the farmers of this section of the State.

We believe the present plan of annual State aid and the representation by one delegate from each thrifty society to be the correct one.

It is with pleasure that I am permitted, in behalf of the Union Agricultural and Horticultural Society, to offer to the Hon. William R. Sessions, late secretary of the Board, our great esteem and respect. We feel he has been a friend in deed. We trust that the present incumbent will be to the farmers of Massachusetts an avenue for benefits financially.

Farmers of this and adjoining towns, this meeting is yours. It is for you to avail yourselves of this opportunity of participating in discussions and submitting questions. I trust the deliberations of this meeting will be fruitful in results.

And now again I desire, in behalf of the Union Society, to extend to you, members of the State Board, a cordial welcome.

The CHAIR. We will listen to a response by General Appleton, a member of the Board by appointment of the Governor.

General APPLETON. I take pleasure in saying only a few words in response to the welcome by the president of the Union Agricultural and Horticultural Society. It was my pleasure to exchange with the delegate from this society, Mr. Blair, who came to the Essex Society when I had the honor of being its president, and I, as delegate, had the honor and pleasure of going to their society as inspector some years ago. I think the spirit shown by Mr. Blair is indicative of the feeling of the Board and of the societies. I know we both in our reports endeavored to say those words and give that advice that would be helpful and critical but not severely critical.

It gives me pleasure to speak to you as an appointee of the Governor, and to come to this town of Westfield and see it, as I have never had the opportunity before, except as I rushed

through on a train. It impresses me as having beautiful and attractive grounds and streets.

As to the Board of Agriculture, I am sure the responsibilities are very great upon us. When I started to write down a few words, I thought of my knowledge of the Board through the local society since 1870, and my connection with it, and if I could not say something without notes I had better sit down and leave the Board and everything else.

To-day the responsibilities of the Board are great, and the first thought that came to me as I sat down was the first lines of a hymn that Mr. Esten will recall, "A charge to keep I have, a God to glorify." That is the position of the Board of Agriculture. The spirit with which that charge should be executed is in the last words. Those connected with the Board know that the Board executes the laws of the Commonwealth that are put into its hands to carry out. It also works for legislation in ways which it thinks will be for the interests of the Commonwealth.

It has been my privilege to travel about this Commonwealth a great deal, and over the country and in other countries, and I know the beauties of this good old State by comparison. I know of its natural beauties in comparison with other parts of the country. We look up the history of Westfield, and we find that the diversity of surface is as great as that in any other part of the Commonwealth.

How different are the conditions to-day from what they were when this Board was started. What have we to draw upon? What have we to help us in our agricultural efforts? In the early days we did not have the Department of Agriculture at Washington, with all its details and with all the expenditures there for our good that we have to-day. It is for us to draw upon, and they are ready to come and help us. We have our agricultural college for our young men to go to, to get an education on an agricultural basis that will train their minds for any course they may adopt. They get knowledge that will help them to advance and ennoble them. You will agree with me that our schools are best if taught on the same plane of instruction. Is it not true that the early training of the mind to cultivate the powers of observation, which is a great basis, cannot be brought about by widely

different courses of instruction? If the parties did not leave the home district, could they not by some course be better suited to remain in these districts to their best financial good? It seems to me that the study of entomology and botany and such subjects will best promote the powers of observation.

I assure you, on behalf of the State, that we are delighted to come to Westfield, and believe the meeting will be promotive of great good.

During the past year we have had in the Commonwealth a meeting in Boston called the Farmers' National Congress; and I think the proceedings of that meeting, soon to be issued and paid for by an appropriation made by the Legislature, and printed in an easily readable form, will command your approval as to usefulness, and I advise you to seek them.

The Chair. An address of welcome by Mr. J. D. Cadle, president of the Westfield Board of Trade.

Mr. Cadle. It would seem utterly unnecessary for me, after the cordial greeting you have received from the chairman of the selectmen, to welcome you. Yet it is a pleasant duty, in behalf of our Board of Trade, to welcome you here. The man with the hoe, with the plough, as is the case with some of you; but as I look into some of your faces you savor more of the study, or the library, or the platform. I rather think some of you may be situated as I am. I have the honor of being a member of the most noted fox club in New England; I have the honor of being one of its chief officers. I never saw a fox in my life except in a cage, and I have never shot a gun since I came to years of discretion. I think some of you agriculturists are of that type.

But whether you are theoretical or practical farmers I do not care, — I welcome you heartily to this our beautiful town. When it was created, God saw it and said it was good. I regret that you cannot see our chief beauties. At this season our town is not at its best.

We welcome you with whole soul. Years ago we tilled our soil and raised cattle that brought us into prominence throughout the country. To-day I regret to say that, of the eight million valuation of this county, less than one million is in the farms. Our factories for manufacturing bicycles, church organs and many other lines of manufacture have

usurped our agricultural products. Go with me less than five miles from here and I will show you a so-called abandoned farm. It has not been cultivated for twenty-five years. I believe it can be made productive if properly conducted.

We are proud of our industries, and of those I speak. Others may tell you of our agricultural interests. We are proud of our schools, we are proud of our State institutions. Years and years ago, generations ago, those farmers, those strong, vigorous, whole-souled men, builded better than they knew when they laid the foundations of our institutions. They saw there should be of the town's income a large amount given to educational institutions. As the town expanded, our educational institutions expanded. We have nothing to which we point with more pride than to these educational institutions. We are proud of our industries; we are proud of our farmers; we are proud that they remain to till the soil, that they have not left the farms.

And so we welcome you, and believe there is a work for you to perform in this community to-day, to aid in the interests of our agricultural products. I understand from one of the speakers that you met here twenty-five years ago. Westfield to-day is very different from what it was then. Twenty-five years ago the fields that were cultivated are to-day covered with factories employing five hundred to six hundred hands. But to-day we have farms to be cultivated and improved; and I welcome you, and I trust this meeting will be productive of good.

Again, in behalf of the Board of Trade, in behalf of our industries, I welcome you. The latch-string of each factory, each store and school and each farm hangs out for your pulling, and we invite you to enjoy them.

The Chair. The response will be by Mr. Walton Hall, member of the Board from the Marshfield Agricultural and Horticultural Society.

Mr. Hall. It is one of the pleasant things in a farmer's life to know that, go where he will, he will find a warm spot for him in the hearts of the people; and the warmth of your welcome, Mr. President, and the warmth of the welcome of the good people of your thriving town were not unexpected by the members of the Board of Agriculture.

I might take your time to tell you of the beauties of Westfield as I have seen them, of your people, well clothed and intelligent looking, whom I have met on your streets, and tell you of the names of the men who have given so freely of their time for the best interests of the people, and have done so much to make Westfield the model New England town she is, but I am sure you would not care to listen to me while I read a list of the members of the Westfield Board of Trade.

It will be one of the sorrows of my life that my children are boys, and that I have no girls to send to Westfield to educate in your girls' normal school, especially since I have been told that the members of the Board of Trade are bachelors.

But I have not come here to praise Westfield or her people, but to tell you of the many beautiful things in the farmer's life, and of the advantages the farmers have over the rest of mankind. Whittier, the favorite poet of the American farmer, the one who lies the closest to their hearts, tells us —

> Give fools their gold, and knaves their power;
> Let fortunes' bubbles rise and fall;
> Who sows a field, or trains a flower,
> Or plants a tree, is more than all.

You tired business men and manufacturers of Westfield, you whose business cares have made old before your time, you who have grown nervous, irritable, unreasonable, hard to please, whose wives and children hear with pleasure the street door slam behind you as you go to your work, let me beg of you to cease existing, even in a good town like Westfield, and come to the country and live. You will find in the ownership of land, and in watching the grass as it starts in the spring-time, — the mantle that nature puts on when she arrays herself in all her beauty, with which she hides the scars that man makes on her bosom, and hides in his hay field, where he leaves them, the scythe and the rake, the mowing machine and the hay tedder of the careless farmer of the west, — that which the possession of no other property will give you. And creeping everywhere through our valleys and over our hills the grass will preserve the shape and keep

sacred the graves of the children of the farmer, when the monuments of marble and of granite that mark the resting places of the city's rich shall have crumbled into dust. You will find no place better to live in than among the farming people. There contentment makes her home, and the laws of God and man are respected and obeyed. Richer lands there are than those in New England. Richer are the lands of Cuba, Porto Rico and the Philippines, but fertile as is the soil of these islands, there is one crop, worth more than all others, that they never will grow there, and that crop is the boys and girls that in the years that have gone have made the men and women of New England and this country what it is. You will find no pleasanter home to which to return than to the farmer's, where not only the wife and children, but the dogs, the horses and the cattle have a welcome for you. And it is for our children as much as for our own sake that we should be farmers; these children who are the cords that have bound together many a husband and wife who would have fallen apart but for them, and have kept the feet of many a man and many a woman in the straight and narrow path that would have strayed from it. For his children the farmer labors as do the men of no other calling; for them he denies himself until he is often called niggardly, determined that they shall have educational advantages that were denied him, caring not if he never becomes known beyond the limits of his own town if his children can only become famous as great men, or, better, as good men, as good farmers. Our cities spend millions of dollars for parks, because they know that their children will be better men and women for being brought in contact with nature and the purity of her works. We want our children to have the same love that we have for this old mother earth that has soothed so many of us in our childish troubles as sobbing we have clung to her, —this old mother that holds in her embrace so many who were once so near and dear to us, and that is to provide a resting place for all, when, tired of care and trouble, weary from pain and the weight of years, we go to the rest, to the peace, that a well-spent farmer's life and a place in her bosom will give us.

The Chair. Good Fellowship of the Grange, by C. M. Gardner, lecturer Westfield Grange.

Mr. Gardner. After the triple welcome that has been given you, it is needless for me to say that you are welcome to Westfield. You have heard from our chief officer, who has offered you greeting; the president of the Board of Trade has offered you the same word of greeting in behalf of the mercantile interests of Westfield; while from Blandford has come to you the assurance that this welcome is not only from Westfield, but from all western Massachusetts. And so it remains for me as a deep privilege to bring to you the good fellowship of the grange. I speak to many who are members of the grange or the order of Patrons of Husbandry, and to some who are not members, but who ought to be. An organization like ours is worthy the support of every man and every woman who believes in the true things of life. Westfield is very much a grange centre. It has No. 20, with two hundred members, representing as good people as there are in Westfield. But I speak to you for a large circle of granges that surround us on every hand, — Southampton, West Springfield, Huntington, Montgomery and others, for which Westfield is the centre. What is the reason the grange has grown? Because of that for which it stands and for which its energies are devoted, — for a broader education of its members, for a better standard of public life, for a better and a purer home life. In our grange the literature used is one of the most important features. Topics of large importance are treated there, matters of history of the highest interest to our members. It is an important factor for a higher standard of public life. The grange stands, and always will, I believe, for the greatest good to the greatest number. But it is not in this that the grange is strongest. It is strongest in that it makes for a better and a purer home life. In what other place will you find the father and the mother, the sons and the daughters, all combining to transact business of a fraternal organization? There they discuss their common interests.

Westfield is a great fraternal town. There is a branch of almost every secret society known, and each new one succeeds. In a year the societies paid out nearly $13,000 of

hard money. We can only imagine what that has meant in the midst of suffering and distress. This spirit prevails in Westfield to a very exceptional degree. I greet you in behalf of the fraternal spirit of Westfield. May your stay be so pleasant that you may go away with light hearts, rejoicing in the time spent here in a town not only with good streets and good schools and large manufactories and prosperous stores, but also a pleasant little city, by the softly falling river, where friendship and fraternity abound and hospitality to an unbounded degree.

The CHAIR. Response by F. W. Sargent, member of the Board from the Amesbury and Salisbury Agricultural and Horticultural Society.

Mr. SARGENT. It gives me great pleasure to respond to the sentiment of good fellowship of the grange, so beautifully presented by the brother. The order of Patrons of Husbandry is one that takes a place in the agriculture of our State, and of our country, that cannot be filled by any other organization. It has become a power in our land. The meetings of the grange do much toward bringing the farmer and his family into close touch and close connection with his neighbors and his friends, and they are the means of educating them in a social and intellectual way.

We meet to discuss not only the agricultural interests, but those of the country and of the nation in general. Our meetings are interesting, they are instructive, and to those who are in the order they are a great benefit. As the brother has said, there are not enough of the farmers of Massachusetts members of the grange. I wish the order might be larger than it is.

The home grange with which I am connected is located in the extreme north-eastern corner of the State. The grange there was indirectly started by a member of the Board of Agriculture. This member came to the western part of the State, and became so interested in the grange work that he went back home and organized the first grange in that section of the State in 1886. We now have eleven strong granges, with a membership of about fourteen hundred people. The work of the grange and the local agricultural society is always carried on in a most friendly manner.

One would hardly know how to get along without the other.

The poem that Mr. Hall recited here was written by Mr. Whittier especially for our Amesbury Agricultural Society. I see in coming to Westfield that we come to a strong grange territory. It seems to me that the work of the agricultural societies and of the grange should be more largely carried on together. We are working for the same cause, — the promotion of agriculture and the education of the farmer, — though on slightly different lines.

We are gathered here to-day from all or nearly all sections of our State; and I know I am expressing the feeling of the grangers in the section of the State where I live, when I bring a cordial greeting to those in this part of the State. Good fellowship in the grange will always be well recognized and supported.

The Chair. We will now listen to an essay by Representative Merrick A. Morse of Belchertown, on "The gypsy moth in the Legislature."

THE GYPSY MOTH IN THE LEGISLATURE.

BY MERRICK A. MORSE, BELCHERTOWN.

The most undesirable and destructive emigrant ever brought to our shores is the gypsy moth. It is a complete counterpart of at least one of the plagues of Egypt, for did not the Lord say, "I will bring the locusts into thy coast; and they shall cover the face of the earth that one cannot be able to see the earth; and they shall eat the residue of that which is escaped, which remaineth unto you from the hail, and shall eat every tree which groweth for you out of the field; and they shall fill thy houses, and the houses of thy servants, and the houses of all the Egyptians." And we read that the locusts were so destructive that not a green thing was left in the trees, nor an herb in all the land of Egypt.

Many of the best citizens of the district infested by the gypsy moth came before the committee on agriculture to testify that this insect had invaded their homes, that their houses and fences were literally covered, that door steps had to be swept before callers could enter, that it was impossible to walk the street without crushing these nauseating insects, and that real estate was depreciating in value. One man testified that he killed them morning, noon and night, without perceptibly lessening the number; and if perchance one fell into a pail of water and remained only a few hours, horses refused to drink from that pail for several days. In riding through forests that are infested, they can be distinctly heard while eating, and the stench is anything but pleasant. From a sanitary stand-point, if from no other, the State should do all in its power to exterminate this pest.

As the locusts of Egypt left no green thing in the tree nor an herb in the field, so the gypsy moth in Europe has

eaten every green thing in tracts of land larger than New England; and, because they could not move to new fields, they actually died of starvation in such quantities that their dead bodies caused such a stench that the government had to come to the rescue, for fear it would breed a pestilence. In France, Germany and Russia, authorities are a unit in telling how orchards are bereft of every leaf and bud, and that forests are as bare in June as January. They also tell us how the gypsy moth is a veritable plague to agriculture, how the hopes of orchardists and agriculturists are destroyed and how people are actually driven from their homes. A distinguished German authority says, "Of destructive caterpillars the gypsy moth may be mentioned first, as being the largest and most ravenous."

I have mentioned a few things to show what this pest is doing in his native land. Now, the question is, Will he be as destructive in the United States? We were told last winter by scientific men that an insect transported to another country, if he thrives at all, thrives better in the new than in the old; and our experience with the gypsy moth proves the assertion. What shall the State of Massachusetts do with this enemy of the tiller of the soil? Three propositions cover the whole ground: first, do nothing; second, keep him where he is; third, exterminate him. There were three distinct classes of persons that came before our committee, the most of whom advocated the first proposition, — that is, do nothing; let every individual care for his own premises. A few advised a small appropriation, — "just enough to hold them in check," was the way they expressed themselves. But the end aimed at by all these was the same, namely, to throw the burden onto the farmer.

Some of these were persons of such a peculiar make-up, whose reasoning was so defective, whose conclusions were so erroneous and whose statements were so near misstatements, that they helped the cause they came to destroy. Let me give you two samples of their statements. One accused the employees of transplanting the moths, and, when pressed for a reason said: "A gang of men came to my orchard, and one of the men marched to a certain tree on which were moths, therefore he must have put them there." The fact

was that the trees on which moths were found were marked, and he also had a map of the whole orchard, showing these markings, and by looking on this map he could point to every tree on which a moth had ever been found. Another said a gang of men working near his house had a picnic. He admitted he did not see them, but heard them talking loud, therefore he thought they must be having a picnic. The men were moving brush, and it was shown to the committee that they had anything but a picnic on that day. I mention these two cases, which are very mild ones, to show the kind of opposition the committee of the Board of Agriculture has to meet.

The second class of persons that came before us to oppose an appropriation were the discharged employees, and they were discharged for cause. From the very nature of the case very little need be said about their testimony, for I think it had very little weight with either the agricultural committee or the ways and means committee. Their effective work was done in the halls, where any kind of a story could be put in circulation; and to the writer's knowledge such stories were used very wisely by the opposition to poison the minds of those who had not made an investigation of the work of the gypsy moth committee.

The third class that came before us to oppose the appropriation was the Boston Market Gardeners' Association. These men seemed to look at this question from no broader stand-point than their own garden. They seemed to think that because they, with several hired men and a few acres of land that were under cultivation all the time, could keep the gypsy moth fairly well suppressed, the farmer, with one hired man and a hundred acres of land, could do the same. These men also thought each individual should look after his own premises. This is the German plan, and if a farmer fails to comply with the law, the government does the work and adds the cost to his taxes. While one of these gardeners was telling how easy it was to spray his trees (and, by the way, he had only a few), he was asked how he would spray woodland, where it was impossible to carry the spraying apparatus by team. His reply was, "Two men can carry a barrel of water through such places."

Just imagine yourself going through swamps, climbing hill-sides, and crawling over ledges with a barrel of water, spraying every tree and bush, and when your supply of water is exhausted, going a mile, more or less, to refill your thirsty barrel. This same opposer of an appropriation said this work could be done for five dollars per acre. Even if it could be, just think what the cost to western Massachusetts would be each year. Just think of the hundreds of acres that would never be treated, and in a few years the dead trunks of the trees would be pointing heavenward like so many monuments, to remind us of our folly. And this mode of treatment would not destroy a single nest, and, as each nest will produce from three hundred to twelve hundred moths, it must be apparent to any fair-minded man that a second and sometimes a third application would be necessary. Such talk is as foolish as it would be burdensome. The advocates of such measures can only be likened to King Solomon's son, when he said, "My father chastised you with whips, but I will chastise you with scorpions."

Reports were put in circulation that the management was influenced by politics. It was even said that one employee, and he an old soldier, was discharged because his Senator voted against an appropriation. The truth was, that the man was in such a condition that he was unfit for business, and one hundred employees knew it, and to preserve discipline he had to be discharged. I am sorry to say that some Representatives, from agricultural districts even, would listen to such stories, instead of searching for the truth. Any one who has any interest in shade trees, parks, forests, orchards or vegetation of any kind, should do what he can to influence his Senator and Representative to vote right in this important matter. Knowing the ins and outs of gypsy moth legislation in the House of 1899, I am convinced that some of the opposition to an appropriation was aimed at the Board of Agriculture. The suppression policy, even if successful, would entail a tax upon future generations. This policy is simply the subterfuge of an enemy. By team and by rail the moth would be carried to other parts of the State, and in a few years would become a national insect. We may as well give up the work entirely, or exterminate this pest.

Can the gypsy moth be exterminated? The committee having charge of the work, after making it a study for several years, says it can be. Leading entomologists of the United States and Canada, some of whom have made thorough investigations, commend the work of the committee, say the moth can be exterminated and advise the appropriation. In fact, entomologists have been employed by the opposition to inspect the work *incognito*, and, contrary to expectations, have made favorable reports and advised the appropriation. I learned that in 1894 there was a very thorough investigation made, by those unfriendly to the work, of all books and accounts, and the investigators became supporters of the committee and its work. In 1896 the Boston Scientific Society made an investigation, and recommended the full appropriation asked by the committee. In 1897 the Society for the Promotion of Agriculture made an investigation, and employed Professor Smith of New Jersey to inspect the work; and his report sustained the committee's belief in the extermination of the moth, and recommended the full appropriation. In 1898 the Massachusetts Forestry Association made a thorough investigation, and its secretary came before the committee on agriculture not only to commend the work of the Board, but to urge the appropriation asked for by the committee. He further testified that experts from Germany think that the work of the committee is correct and wisely carried on. He also said that marked progress had been made the past year, and the methods now being used would exterminate the moth. In 1893, the committee having charge of the work asked for $165,000; $100,000 was appropriated. In 1894, $165,000 was asked for; $100,000 was appropriated. In 1895, $200,000 was asked for; $150,000 was appropriated. In 1896, $200,000 was asked for; $100,000 was appropriated. In 1897, $200,000 was asked for; $150,000 was appropriated. In 1898, $200,000 was asked for; $200,000 was appropriated. In 1899, $200,000 was asked for; $200,000 was appropriated.

I have no doubt but what there would be very few gypsy moths in Massachusetts to-day if the full amount asked for had been received during the years 1893 to 1897 inclusive. The last two years the full amount asked for has been received,

and such progress has been made toward extermination that in eight towns that have been infested not a moth was found last year, and in as many more only a very few were found, and in the other towns in the infested district the people say you can't find one moth where formerly hundreds could be found. All this progress has been made, notwithstanding the fact that the appropriations were made so late in the session that the egg-killing season had partly or wholly passed. One application of a mixture used for the purpose, applied to a nest by one stroke of a brush, will destroy several hundred eggs; but, if allowed to hatch, it takes a long time to find the individual moths.

Considering the disadvantages under which the Board of Agriculture has worked, it is surprising that so much has been accomplished; and not one of these disadvantages would ever have existed, had it not been for ignorance or spite. The question was asked many times last winter, "Why don't you exterminate the potato bug?" When this bug first came from the mountains and began to prey upon the labors of man, an entomologist of Illinois asked Congress to appropriate $15,000, saying it could be exterminated with that amount. Congress laughed, and the potato bug multiplied until he fills the land, costing this State alone nearly or quite $75,000 per year. The potato beetle is no more to be compared to the gypsy moth than the light of a tallow candle is to be compared to the brightest electric light. There were a few in the House of 1899 that talked economy when agricultural interests were being considered; but, when some other matters that required larger appropriations were being discussed, were as quiet as a corpse. When $200,000 are appropriated for gypsy moth purposes, it costs the farmer 8 cents for every $1,000 of taxable property. An attempt to eradicate the gypsy moth from his place cost General Lawrence of Medford $3,000 in one year, and he met with such poor success that he came to the committee for help. If General Lawrence could not cope with the gypsy moth, how can the average farmer?

Such epithets as "fraud," "humbug," were often applied to this important work; and we occasionally read articles in newspapers published in western Massachusetts in which these terms occur. After listening to testimony for more

than two weeks, two committees, composed of some of the ablest men in the House and Senate, reported in favor of the appropriation. They saw nothing that looked like fraud, and they saw no humbugs, unless it were some of those who appeared in opposition.

Others said, send to Europe for parasites. There are parasites that feed on parasites, and it would require the careful experiments of an entomologist for several years to be at all sure of a parasite that would feed on the gypsy moth. Parasitical experience in Europe is very far from being successful.

One other method resorted to by the opposition to catch votes was the introduction of the following amendment: "The sum of $100,000 is hereby appropriated, to be expended in exterminating the gypsy moth and the brown-tail moth. This sum shall be apportioned by the State Board of Agriculture among the cities and towns which are infested by the said moths, or either of them, in such proportions as they shall deem just; but, no city or town shall receive its part of this appropriation until it has raised for the same purpose a sum equal to one-third of that apportioned to it as aforesaid. The said sums, both those apportioned as aforesaid and those raised by the said cities and towns, shall be expended by and under the direction of the said cities and towns for the said purpose." Under this amendment, if any city or town failed to make an appropriation, the whole plan of extermination, or even suppression, would fail. If one section of a city or a town was cleared and a contiguous section of another was neglected, nothing would be accomplished. The gypsy moth has no respect for boundary lines. No city or town has the facilities or the knowledge to successfully cope with so formidable an adversary as the gypsy moth. I became convinced last winter that no business of the State received better thought, closer attention or more economical management than the matter under discussion.

It is your duty and mine to stay up the hands of the Board of Agriculture and its secretary in the tremendous efforts they are putting forth in behalf of the agricultural interests of the grand old Commonwealth of Massachusetts.

Adjourned to 2 P.M.

Afternoon Session.

The meeting was called together by Chairman Wood, who said: The time has arrived for the meeting to come to order. Mr. W. A. Kilbourn of Lancaster will preside this afternoon.

Mr. Kilbourn. No department is more important than that which claims our attention this afternoon. Dairying stands at the head, and no man is better informed or better able to give you instruction than the gentleman to whom we have the pleasure of asking you to listen this afternoon, — Ex-Secretary Sessions.

Mr. Sessions. You are well aware that my connection with agriculture for the last dozen years has been more theoretical than practical. In previous years I did something at farming, and did the best I could. Since then there have been a great many changes, and a great deal of new light has appeared; a great deal of investigation has been carried on since the time of my active dairying. What I have to present to you, you must receive remembering those conditions.

DAIRYING.

BY HON. WM. R. SESSIONS, SPRINGFIELD.

It was with great reluctance that I accepted the urgent invitation of your secretary and committee to address you on this subject. It was not because the subject lacked importance, or was untimely, for dairying is easily the most important branch of agriculture in Massachusetts, if not in the United States. It was because, from my limited experience in days gone by, I feared I would be able to throw no new light upon a subject that has been treated before this august Board, within the last few years, by the foremost experts of this country and Canada. I have, as you know, in the past had something to do with making up programmes and securing speakers for your annual public meetings; and I accept the invitation as a compliment from you on my success in providing you with speakers, from time to time, who have interested and instructed you and the dairy farmers of the State in matters pertaining to the various phases of the dairy question. This subject has been treated, by one and another, on almost all points; and I may be pardoned for saying that in the annual volumes of "Agriculture of Massachusetts," for the last twelve years, may be found a library of instruction on dairying that will well repay the careful study of every man who keeps a cow.

Importance of the Industry.

As I have said, dairying is much the most important branch of agriculture in this State. By the last State census the value of the agricultural products of Massachusetts for the census year was $52,880,431. Of this total value, one-third, or $16,234,049, was that of dairy products. More than one-third of the remainder, or $12,491,090, were hay, straw and

fodder, which were largely produced for and used in our dairies. Massachusetts is a State of cities and large towns. Its population is almost entirely made up of consumers of agricultural products. Less than nine per cent of its inhabitants are engaged in agriculture, while the other ninety-one per cent depend entirely upon the market for their food, of course including milk, butter and cheese. The sale of milk for consumption as milk is the most important branch of Massachusetts dairying, and it must in the nature of things so continue. The demand for milk is constantly increasing. But there are many farms on the hills of western Massachusetts so remote from markets or railroad trains that the sale of milk is impracticable, and it must be used for butter making. The demand for prime butter increases with the increase of population. Therefore dairying must continue to be the main dependence of a large majority of Massachusetts farmers.

Where and how to get the Cows.

It is the universal complaint that profits are small, and that many producers hardly get a new dollar for an old one. It is well known to all dairymen that a good cow, or one giving a large yearly yield, will profit her owner, while the average cow will hardly pay for her keep. This truth has been demonstrated by lecturers and essayists before this Board, and figures given to illustrate the fact. I will not take your time to again argue the case, but will assume that you all accept it as an axiom in the dairy business. We *must* have good cows. It is possible to purchase them, and a good judge with a long purse may in time get together a paying herd; but he will meet with many disappointments, and will be obliged to try and try again. Those who sell are loath to sell their best. The cow that kicks over the milk pail, gores the peaceable members of the herd, jumps the pasture fence, has had an attack of garget, has a slight cough or has some other trick or imperfection, is always for sale. Still, with the able and minute directions of Hoard, Twitchell and others in mind, a good trader should have courage to try the market for cows that will pay a profit. In fact, that is the only source of immediate relief.

But, remembering that "like begets like," it is the part of wisdom to endeavor to perpetuate the qualities of the satisfactory cow by raising her female progeny. With this course in mind, the dairyman should be most critical in the choice of a bull; only thoroughbreds should be considered, and the one selected should be from an ancestry that has the milking qualities desired to be perpetuated in the herd. To decide whether a cow is in all respects satisfactory, a record of daily yield should be kept through the entire year, and the quality should be ascertained. The Babcock test furnishes a simple, inexpensive and reliable method for testing the quality of milk. By regularly testing the product of his dairy, and eliminating the cows that give poor milk, the milk farmer may be saved from anxiety about the visits of the agents of the Dairy Bureau and State Board of Health, and also enjoy the satisfaction of knowing that he is furnishing his customers with what they pay for.

The raising of calves goes naturally with butter dairying, as the skim-milk is a waste product that can be profitably utilized in feeding the young animals. With the present demand for cows and the prices that good ones command, this incidental to butter dairying may become a large factor on the credit side of the business. A regular system with careful attention to all details may easily provide a yearly income from the sale of cows, and not the least advantage will come from the opportunity to retain the best in the home herd after trial shall have proved which are superior. My experience has proved that skim-milk, with suitable additions of flaxseed, either in the form of seed or meal, wheat middlings and bran, oat and corn meal, will grow calves creditably, and produce better cows for dairy purposes than new milk nursed from the mother cow. The young heifers will not be as fine show animals, but will be all right for a working dairy.

The milk-selling dairyman is at a disadvantage in raising calves, because the skim-milk is lacking. In most cases he could not profitably raise cows for market; but I believe he would find it to his lasting advantage to raise nearly or quite a sufficient number to keep his herd at the maximum, and thus escape the disappointment and loss he must meet in

purchasing cows in market. Calves can be raised without milk after the first two weeks; and, with close attention and good judgment, very little milk is absolutely necessary after the first week. The above-named grain feeds must be the main dependence. For the first few weeks they must be fed in the form of porridge, but it is surprising how quickly a young thing will learn to eat these feeds dry. When they have accomplished that, the field is won.

A leaf from the experience of Hon. Thomas P. Root, a Barre milk farmer, may be of value as an illustration. In the summer of 1886 I saw in his barn fifteen heifer calves growing finely, while he was sending all his milk to Boston daily. In reply to my inquiry, "How do you do it?" he said: "I teach them to drink with new milk. As soon as they begin to drink, I sprinkle a little old-process oil meal into the milk, in order to have them acquire a taste for it. As soon as they have learned to love it, which will be in a very few days, they will drink almost anything that has the taste of oil meal. For a regular diet for the calf after it has passed that point, I take one part of oats and one of wheat bran by weight, have them ground together, then add one part oil meal, mix well together, and cook by putting it into cold or lukewarm water and stirring as it is heating, to prevent lumping. I watch the condition of the bowels, as the danger in raising calves without milk is almost entirely in this direction. Careful variation of the amount of feed will almost always control this trouble." These fifteen calves were shown at the fair of the Worcester County West Agricultural Society in 1886, and again in 1887 as yearlings. They were a fine lot in 1886, and in 1887 were remarkably good, and as even a lot as I ever saw together. They were all added to Mr. Root's herd of milkers at two and a half to three years of age. He assured me that nearly every one proved a fine milker, and that the experiment was eminently satisfactory and profitable. He knew them and they knew him, and they were at home when they began their life work. The owner was saved the disappointments that always come with a lot of purchased cows, and the young cows escaped the excitement, nervous strain and other evil effects that come with change of owner and home and the exposure in going

to and from market. If we believe Governor Hoard's teachings on "the dairy temperament of cows," we shall be ready to ascribe very great importance to the last-mentioned factor in the matter. I am not giving a recipe for raising calves, but only indicating a course that has been successfully followed.

In leaving this part of my subject, I must call your attention to the fact that calves being raised in this way are in an artificial condition, and must have the best of care and closest attention. To succeed in this, as in any other business, one must have a taste for it. If a man can get no pleasure from his work, he will not be likely to make a marked success; while, if he loves his work, the study, care and attention he will bestow upon it will insure success. This is as true in the care of the dairy herd as in the rearing of calves, and success in feeding the dairy cow is often quite as much dependent on the care and watchfulness of the interested owner as upon the system pursued. To keep a herd economically is a most important part of successful dairying. Economy is not parsimony, but judicious expenditure; and a liberal but judicious system of feeding must be followed, if financial success is to be attained. Most Massachusetts dairymen follow the business because the cows furnish a home market for much of the produce of the farm. I believe that many dairymen neglect the opportunities that the farm affords for the production of cow feed. A fairly balanced ration must be fed, to insure a satisfactory yield of milk; and it is easier to bring the necessary materials from the feed store than to grow them upon the farm. All that can be grown economically should be thus provided. Good pasture feed is the cheapest and best supply, in its season, if it can be always abundant. But this is impossible on the hill farms of Massachusetts, and arrangements should be made to supplement the pasture feed at any and all times when the supply is lacking in the least degree. The cow must always have sufficient food, without excessive labor in securing it; but, to make the most of our pastures, the feed must be cropped when fresh and succulent, and they must be stocked with a sufficient number of animals to keep the feed closely cropped all over them. Our hill pastures have many spots where the feed is not the sweetest;

and, if the cows can satisfy themselves on the part that grows the most palatable herbage, they will leave the less desirable untouched. If these places are not fed off in the beginning of the season, they will be entirely neglected, and left to grow up to ferns and brush. To get the most from the average Massachusetts pasture, a sufficient number of cows to feed it closely should be turned on it quite early in the season. The cows should always have a feed of hay at night for the first few days they are in the pasture; then, to insure sufficient feed in all exigencies of weather and season, a supply of green or soiling feed should be planned for.

A regular system of feeding is best in summer, as well as in winter; and the cows should have a daily feed in the stable, larger or smaller, as the supply of pasture feed varies in abundance. Sometimes a small feed of grain is all that is necessary; but abundant provision for green feed should be made, for New England droughts have no settled habits, and may put in an appearance at any time from May to November. If the pasture feed is luxuriant, any surplus of green feed can be dried or ensilaged for winter use. The green feed should be fed at night, so that the cows may go to the pasture hungry; otherwise they will lie down and spend the early morning in chewing the cud, and when they are ready to go to feeding the sun may be so hot on warm days that they will prefer lying in the shade to feeding short pastures, and so get little good from them. A grain ration in the morning would not have this effect.

Those who have had experience in the dairying business know that, when the cows once drop off in yield, it is impossible to bring them back again. It makes no difference how carefully you attend to them, you can never get them back again. If you keep them at their best, they will go through a season and furnish a very much larger yield than they will when a hap-hazard plan is followed. If there is plenty of food in the pasture, I would bring the cows into the stable every night, and feed them something, if not more than a pint of bran. If you are in the habit of leaving the cows in the yard and food becomes short in the pasture, you keep putting off feeding them, and the evil is accomplished before you know it. My point is to have a regular method

of feeding, and pursue it in the summer just as well as in the winter. I believe this is the only way to get the most from a dairy cow.

Rye sown in August or early September will furnish green feed as early as it is needed. Another sowing late in the season will provide sufficient to last until spring crops are ready. As soon as the soil can be worked in the spring, a patch of spring rye, another of barley and peas, or oats and peas, should be put in. Two or three weeks later, a second sowing of oats and peas will provide the necessary green feed, until corn from a patch of an early variety, planted as early as possible, is ready. The dependence for late summer and autumn should be corn, and an abundant supply should always be provided. The ground from which the early cuttings of rye and oats are made can be planted to corn, and that from which later cuttings are made may be sown to barley, which will make excellent feed after frost comes. All these crops should be grown on fertile or well-manured land, so as to insure an abundant yield. Cows much prefer sweet corn, and evergreen sweet corn will yield as much feed as any other variety. Many successful milk producers consider it preferable to any other sort for the main dependence. Rye should be cut before the head is grown. Corn should be planted thin enough to insure an ear on each stalk, and it is most valuable for feed after the ears are grown.

To make a balanced ration, some concentrated feed rich in protein should be fed with the rank-grown soiling feed. Wheat bran, gluten meal, oil meal and cotton-seed meal are always in the market, and all are rich in protein. There are numerous other by-products of manufactures on the market, many of which are economical sources of protein. These articles vary in price from time to time, and the bulletins and reports of the experiment stations furnish the information that will enable the dairyman to select the feed that will furnish the needed protein at the cheapest rate. Much labor and thought have been expended by the experiment stations in efforts to discover crops that will be good substitutes for purchased feed stuffs rich in protein, and that can be economically raised on the farm. Such crops have been

discussed in the station reports and in lectures and essays by professors; and doubtless under favorable conditions something can be saved by raising and feeding soja beans, vetch, cow peas, Canada peas and clover. Clover should always be sown with grass seed on a dairy farm, and where it does well may be profitably raised for green fodder or ensilage.

In this latitude the corn crop is God's best gift to the dairyman. It is a native of the country, and will always give a crop with the minimum amount of labor. As a feed it is suited to our climate, and is relished by the cows as grain, green feed, ensilage or dried fodder. The cows always find more in it than the chemist does. It can be preserved in the silo throughout the year in a succulent condition. It will furnish a greater amount of feed per acre under ordinary circumstances than any other crop. It will grow on all kinds of soil. It will respond to high manuring with a profitable yield. It will furnish the carbohydrates or heat-forming elements of cattle food in the very cheapest form. High authority has advocated that the dairyman's farm should produce all needed carbohydrates, and that the market should only be resorted to for the purchase of protein. Professor Hills, in his admirable paper delivered before this Board last year, said that carbohydrates were grown upon the farm with relative ease; but it was difficult and usually impossible to grow enough protein upon the farm to provide a large number of dairy cows with a balanced ration; that, since the by-products of several industries are notably rich in protein and are sold at fairly reasonable prices, it is sometimes cheaper to buy this material than to raise it; that, while the farm-growing of protein was to be encouraged, yet it was usually in the line of economy to grow carbohydrates in as large amounts as possible, and to buy protein in order to supplement this growth, thus properly balancing the ration.

I cannot leave the subject of providing feed for the dairy without urging the economy of storing more corn ensilage than is needed for winter feed. If properly put up, it can be kept indefinitely; and in this way provision can be made against next season's drought, short pasture and short hay

crop. Ensilage will do very well in place of green feeds, and in many cases can be more economically provided. This is the case when the land for green crops is at considerable distance from the barn.

I have had very little experience myself with ensilage, but I can see no reason why a man would not be safe in putting up double the amount he needs for winter, and use it in case of a summer drought or short hay crop. If he does not happen to need it, he can use it the next year. Of course you understand me to say, "if properly put up, in a perfectly constructed silo." If farmers and dairymen would act in that way, they would fortify themselves against such an unfavorable season as we have had the past summer. Some have said to me that it has been the worst year they have ever experienced. If every farmer had carried over a silo full of ensilage, it seems to me they would have been prepared to meet this season.

The Pasture Problem.

Much has been said and written about the decadence of our hill pastures. It has been argued that the dairy cow has robbed the pasture; and that the farmer, instead of returning the elements of fertility removed by the cow, has left the pastures to run out and grow up to wild growth and wood. If the pastures are stocked with a sufficient number of cows to consume the luxuriant growth of June feed and keep all parts of the pasture fed close throughout the season, and if these cows are fed in the stable to make up for what the pastures fail to provide in late summer and autumn, the cows will leave as much fertilizing material on the pastures as they remove in feed. The concentrated feeds recommended to balance up the green feed and ensilage are rich in fertilizing elements. My own experience is that pastures treated in this manner improve year by year. Only a small annual outlay to prevent the brush from gaining possession and for reasonable care of the pastures is necessary to insure as good pastures as our fathers had in the early days.

A few days ago I rode in sight of the old pasture where my father used to pasture ten cows. When we had a dry season they shrunk half the yield, and it affected the product

for the rest of the year. When I began to run the business, I wanted to keep twenty cows; and so, after reading and studying other people's experiences, I decided to use grain feed somewhat in the way I have indicated here. I put twenty cows into the same pasture where my father kept ten. After haying the first year, I went at the bushes. It was a tremendous task, — it was a mountain pasture. The next year there was better feed, notwithstanding there were twenty cows instead of ten. We cut the brush every year and the feed increased. I think if the fathers could see the pasture to-day, they would say it was just as good as it was a hundred years ago. It certainly produces more feed than it did fifty years ago. The expense of cutting the brush was pretty severe the first year, but the annual expense grew less and less, and now we have to just clip here and there a bush. The point is, in feeding a cow in the stable, if the food is rich in fertilizing material, she leaves as much of the fertilizing element on the pasture as she takes from it.

Dairy cows also furnish fertilizing material to keep all parts of the farm productive, and this should be set to the credit side of the business. This point might be elaborated at length, and my subject would seem to justify such a course, but time will not allow it.

Care of Cows.

Cows should always be kept comfortable and happy. The best cows have a fine-strung, nervous organization, and are much more susceptible to bad influences than stolid beef or work animals. All the energies of such cows may be engaged in milk production; and how foolish to allow them to be in part expended in long tramps in search of food or drink, in resisting cold, in warming ice water, in working up an extra amount of poor or unbalanced food, in counteracting the effects of fright, abuse or discomfort of any kind. The moment a good cow is uncomfortable or unhappy from any cause, her product begins to diminish in quantity and quality. Cows are creatures of habit, and will accustom themselves to any reasonable conditions and surroundings. It is folly to assert that any single plan of management is in all respects the best Keep a prime cow in a state of

perfect complacency, and with sufficient suitable food she will devote all her energies to the production of milk. Governor Hoard has told us that each cow has her own limit of production in quantity and quality, but we need not expect her to approach that limit unless all the circumstances are favorable.

Care of Dairy Products.

Dealers in milk and consumers also often make bitter complaints about the uncleanly condition of their milk, and that it fails to keep well. This is a serious matter to producers, for, if the consumption of an article is to increase, it must give satisfaction to those that use it. All cows in a working dairy should be in perfect health, and be always kept in a placid state; should be provided with clean, wholesome food and pure water; should have pure air to breathe; be kept clean and be milked regularly. The milk should be sacredly guarded from contamination by filth and foul air, and should be cooled as soon as possible. It should also be kept at an even, cool temperature, until it appears on the consumer's table. So much of this as is the part of the producer to attend to should be most scrupulously performed. The producer of milk that is to be made into butter at the creamery is in honor bound to take most scrupulous care that the product of his dairy shall always leave his possession in perfect condition. If he does not take such care, he is defrauding his careful neighbor of a part of his rightful income. Every batch of poor or contaminated cream reduces the quality of the whole of which it forms a part. The great complaint of creamery managers is that the cream is not received in perfect condition, and that the consequence is reduction of quality and price of the butter. The private dairyman injures only himself in matter of price by his neglect; but is it not an imposition upon the consumer to put upon the market an article that is inferior by reason of neglect to guard the milk and cream from contamination by filth and foul air? It is well known that milk is more easily injured by standing in impure air and in contact with foreign odors than any other article of food. Milkers are often neglectful. If scrupulous care is not taken to keep

the cows clean, dirt will get into the milk pail. If the milker is unclean in hand or clothing, there is danger that the milk will be contaminated. If the stable is ill-smelling and unventilated, the milk will absorb foul odors. If the milk is allowed to remain in contact with the atmosphere and subject to its changes of temperature, it will receive the seeds of decay, which quickly multiply and spoil it. In years gone by consumers were satisfied with tub butter in winter; and the farmer could make his yearly product during the pasture season, and the market would take it at remunerative prices. That day is past. The market now demands new, sweet butter in winter, as well as in summer. The milkman must have a constant supply throughout the year. The day of profitable summer dairying has gone by. The progressive dairyman must provide an even supply for all seasons. The task is no holiday one.

Papers on Dairying.

In the beginning of this paper allusion was made to the value of papers on dairying contained in the last few volumes of "Agriculture of Massachusetts." In looking over the papers that have been presented at these meetings, I was surprised to find how much attention has been paid to this subject in the last dozen years; and I was surprised to find how thoroughly all points at issue had been gone over, and also the valuable authority we had. Some of the gentlemen have come from long distances; some have given their whole lives to dairy investigation; others were practical men, who had made a success themselves in dairying. It occurred to me that perhaps a list of these papers might attract the attention of young men who had not attended the meetings and had not seen all the volumes of the reports of the Board of Agriculture. The list may be useful, as these volumes may be obtained by applying to secretary of the Board of Agriculture: —

Ensilage in New England, 1887.
Creameries, 1887.
Milk farming, 1887.
Co-operative dairying, 1888.
Economical disposition of the wastes of the dairy, 1889.
Grading up dairy stock, 1889.
Economic disposition of milk, 1889.

Care and management of milch cows, 1890.
Dairy temperament of cows, 1890.
The agricultural situation, 1891.
The Channel Islands and their agriculture, 1892.
Home-grown or purchased cattle feeds, 1892.
The handling and feeding of dairy cattle, 1893.
Summer and winter feeding of dairy cows, 1894.
The milk supply of Massachusetts cities, 1895.
The necessities and demands of modern dairying, 1895.
Rational stable management, 1895.
The dairy interests of the United States, 1896.
The food value of dairy products, 1896.
Private dairying, 1896.
Creamery experience, 1896.
Making milk for private trade, 1896.
The Babcock milk tester, 1896.
Concentrated feed stuffs, 1896.
Milch cows, -- structure as related to production, 1897.
The milk supply and the public health, 1897.
Why milk sours, and how souring can be prevented, 1897.
How can New England compete with the west in dairying? 1898.
Grasses and other forage crops, 1898.
Catch-crops, 1898.
Milk and cream, 1898.
Stable management, 1898.
Tuberculosis and the milk supply, 1898.

Most of these papers were presented by experts or eminent students of the dairy problem.

To succeed as a dairyman in this day of critical consumers, a man must be alert, industrious, painstaking and a student. He must love his cows and his business. Dairying should be dignified as a profession; and he who achieves a marked success in it is worthy of as much honor as the successful lawyer, merchant, manufacturer, soldier or statesman. In this paper I have endeavored to give an outline of some necessary things in successful dairying, in the hope that some of the points may provoke discussion. The most valuable instruction often comes from the audience, when it is allowed to criticise, discuss and ask questions. If you will now do your part, the hour will not have been wasted, though this paper may have only re-stated well-known truths.

The Chair. I think it is quite clear that the experience of ten or twelve years ago is still fruitful in giving to us practical points of instruction, to which almost all of us will do well to take heed. We will be glad to hear from any one who has questions to ask or statements to make. We will be glad to hear from Dr. Twitchell.

Dr. G. M. Twitchell (of Augusta, Me.). I did not need a hint from your worthy secretary yesterday to turn my attention to this winter meeting. For the past ten years it has been my good fortune to be able to be present with you at all but one or two of your annual sessions. As I read the programme over, and saw in the list of valuable papers to be presented, one by the well-known expert, a desire sprung within to go back and meet again the old friends who have been engaged in this work for so many years. Chance favored, and I was able, by riding last night, to spend this afternoon with you, and to listen to the honorable ex-secretary, who always spoke by the book and always gave us something to remember.

There are two or three points in his admirable paper which I want to touch upon. He says you determine the value of a dairy cow during the first six months, or early in its life. I would say, during the first six months of her existence. I firmly believe that the time has come when we must realize that the mental influence of the man is the chief power in the control and development of the herd, and I believe we should feel that that must be exerted from the first. We have been living through the objective mind of the owner and the subjective mind of the cow, until she has reached a point in dairy development where it seems to me a forward step must be taken by the man at the helm. We must enter into a clearer comprehension of the essentials which enter into a successful dairy cow of to-day, because it is of to-day and with to-day we have to deal. I think if you will read some of the papers presented ten or twelve years ago you will see that the standard of production that was set at that time has already been passed. We should measure the quality of our herds to-day by the highest standard reached by any individual member of that herd, and not by the poorest. If it is possible for us to open the way in the breeding of to-morrow by raising the calves, we will surely raise the standard of production of the dairy cow of the next generation. In order for this to be possible, it seems to me that we must all of us have a larger proportion of cow-intelligence. She is something more than a simple machine, to take food that we give her and transform it into

a given product. Men are like trees; you can change the size, but not the sort. We must enter into a closer sympathy with our dairy cows. As I study this question, it grows on me more and more. In order that we may succeed to-day, it is necessary for us to come into closer sympathy with the animals under our care, and that we have a larger conception of what the animals are and what they can do for us. We should realize the fact that the milk and butter fats are the products of nerve force, and are developed by the brain of the animal. Does it not fall upon the owner with heavier force to-day than ten or fifteen years ago that he led the cow out into larger fields of usefulness by the development of that animal? If this is true, during the early stages of the animal's life we are to fix the standards which determine the quantity of the product, and prevent turning attention toward the formation of fats. So, by our methods of treatment and the thought of what the future work is to be, when the calf comes to maturity it will be ready to do all that is possible. I say this because it seems to me that the competition of the future and the necessity of to-day compel us to study this question from every stand-point by which we may increase the product of our cows. We cannot be content with one hundred and twenty-five pounds of butter; we must have two hundred and fifty, two hundred and seventy-five or three hundred pounds, — all the while reach after a little more in each animal and in the next generation.

So, to be a successful dairyman to-day, there must be a mind with large conceptions. I do not know of any chance in agriculture for a man to succeed who has anything else. We have been passing through a stage of depression. I believe one of the great causes for the depression of our farm property is that we have been looking on the dark side of life. We have not started out with a positive will and determination to seek to do the largest and the best of which we were capable. As the outcome, we have been doubting the question as to whether there was a future for agriculture, whether there was ever going to be a chance for the New England farmer to succeed. The press has been adding its weight.

To-day the man who is in love with dairy cows realizes that he must go to them with a large thought; not only with kindness and sympathy and a positive will and purpose, but with large conceptions. Gentlemen, what are we dealing with? An animal who is ready to yield up five, six, eight, ten times its gross weight every year for our profit; who will waste its body to preserve its individuality. We are talking about intensified motherhood. If there is any spot in the world where a dairyman should feel reverent, it is when he sits down by his cow. If he allows his thoughts to reach beyond the milk pail, he will think of the mysteries, he will be questioning as to the how and why, and touch some of the greatest mysteries of life, — mysteries that overwhelm the man. Yet the solving of these mysteries is one of the duties and the responsibilities that fall upon the shoulders of a successful dairyman to-day.

No man can succeed in leading out the possibilities of a good dairy cow unless he can enter into sympathy with that cow and into close fellowship with that cow. Sometimes we laugh at these things. Behind it all there is a great question for us. When we realize its magnitude, we will see what there is involved in it. It seems to me as though this thought should make us all reverent. We are realizing so much and we can comprehend so little of what is involved in it. It is along the lines of the temperament that a man enters into fellowship with his cow.

No man can succeed as a breeder of dairy stock to-day unless he has an ideal. There must be in his mind a point to which he is striving, and he will direct all his efforts to the perfecting of the temperament along that line; and in doing that, as he enters into fellowship with his cow he will find that he has fixed these characteristics.

It seems to me that the lesson is this: we must discriminate between the animals, for one man will succeed with an animal, and another man will fail with the same animal. Some of you have laughed when you sold a cow because you had gotten rid of a poor cow, and the other man makes her a remarkable producer. That is simply an illustration of the thought I have expressed. No man can succeed with all animals. One should gather around him those in sympathy

with him. If you have a dairy cow that will turn around and lap you, — thinks you are her calf, — she will give the largest amount of milk possible. That is what I mean by sympathy. If you have a cow that is nervous, begins to move and is uneasy as soon as you come near her, you better let some one else milk her.

All these factors enter into the successful dairying of to-day and to-morrow. We must be positive in our work. We must have ideals, and work for a positive purpose. When we do that, our doubts and fears will pass away. When we get hold of a great problem, we should seek to bend our energies to the solving of all the mystery, and reach out to-morrow for a little more than we are getting, then we are being fitted to succeed.

In the State of Maine there have never been so many calls for farms as during the past five or six months. We are passing out of the shadows which have been placed upon agriculture during the past eight or ten years. I believe a better and brighter day is coming. And it has come out of our convictions, out of our faith in ourselves and our belief in the future, in return for earnest, consecrated work; because we are beginning to realize the science is reverent; we are coming to feel that it is leading us out to a larger comprehension of the great mysteries surrounding us, and feel that over and above us there is a Providence working through us for the development of all that is bright and beautiful in life. Keep on looking for all that is bright.

Mr. Joshua Clark (of Tewksbury). The remarks of the speaker reminded me of the history of a cow, and I thought I would tell it to you. I have been a farmer, and have earned all I have by farming. I have always been fond of cows. My chief business has been raising milk for the market. The thought that the speaker gave me was this. I never raised but a very few cows. The mother of the first cow I raised was a grade Durham, and a very large milker. The father was a thoroughbred Jersey, and one of the first brought into Massachusetts by E. M. Reed. I brought the calf up by hand. I loved the calf, and the calf loved me. As she grew older, when I went down into the woods to chop, as we used to, that heifer would follow me to the

woods and stay all the afternoon and come home with me at night. I never had to break her into milking, and any time I went into the pasture where she was with the other cows, I would say "Bonnie, come," and she would always leave the cows and come to me. I kept her until she was eighteen years old. I never caught her doing a wrong thing in my life. She was the only perfect being I ever met in this world. She never kicked over a pail of milk; she was never sick, and after I had disposed of her I almost wished I had kept her another eighteen years. That is a little in the line of Dr. Twitchell's remarks.

I would not say exactly as Mr. Sessions does in regard to disposing of a cow if she has a fault. I remember a man in Lowell who wanted to get a perfect horse. Some one said, "You cannot find a perfect man, and a man is a fool if he expects to find a perfect horse." I have one cow in my barn to-day that will jump any fence. I put her in a good pasture and she fed all she wanted to, and then jumped over into a poor pasture. She will jump any wall. I have kept her in the barn two years, and she averages twelve quarts a day. She is worth keeping, if she will jump.

Another thing, in regard to the cleanliness of the milk and the care of the cattle in the barn. They should be fed regularly and given good air. I have carried milk into the market for nearly twenty years. At one time the milkman complained that the milk soured. I marked the cans, and when he brought back what had soured I found that it had been gone nearly a week. I found I must stop making milk or stop selling it at the door. Now I run it into the Lowell market. I did not buy a milk route. I tried to put up milk that would be satisfactory. We could have three times the route we now have. We always get six cents the year around, while most of the milkmen sell for four and five, and get six only in the winter. It is very important to keep the milk clean. We always wash the cow's udder every time we milk. We put the milk into a large strainer pail with a wire strainer, and run the milk through that and two or three thicknesses of cloth. In that way you will hardly ever find settlings in the milk.

I feed gluten and wheat shorts, and I think with this food

the cows have less garget, and will give more milk than with any other food for the same money.

As I stated to-day to a member of the Board, you cannot lay down any conditions for every farm. If I had some farms I would have a silo, and if I had some others I would not. On my farm I have not built a silo, because I thought I could get food for the cattle cheaper. I do not suppose many of you know how much food can be got from a load of cabbage. Some of you will say it will not make good milk. You may feed green rye to a cow, and when you begin, if you feed all she will eat, the milk will taste. When you first give it to them, any feed will affect the milk. I have not raised any fodder corn for a long time, because I could not afford to, on my farm. I raise sweet corn to feed the cows. I am near the market, and sell all the ears I can; then I do not care how many are left on the corn to feed the cows. It is the best food you can give them. In this way I can make it pay.

The feed one can get from an acre of cabbage is wonderful. I take the cabbage to market, and feed the trimmings to the cows. I begin by giving a very small feeding after milking. Always feed the cabbage after and never before milking, and it will make very rich milk. There is no question about it, and the milk will be sweet, too. This has been my experience.

In farming, each one has to use his own brains and his own way, and then he will make a success. I have heard of men trying to talk like somebody else, but they make failures.

When I was seventy-two I let my son take the farm, and kept only three or four acres, — just enough to keep me out of mischief. The last three or four years that I sold milk I kept an average of sixteen cows. I did not raise cows, and very seldom let them have a calf. In looking back, I found the gross sales of milk for the last three or four years were one year a little over $2,700, the next year a little over $2,800, and the last year a little over $2,900. I do not know as that is a large average. I sometimes think a little practical talk is a help to us. I have had a great deal of help from farmers' meetings, and especially from our ex-secretary. He always gave us something worth hearing.

The Chair. I was struck with one point Mr. Sessions made in reference to the fifteen calves. He left out one point, — out of the fifteen, some must have been failures.

One other point to which he did not refer. The herd must be replaced every few years, and if a farmer raises his cows, he is likely to get those free from disease. This is an advantage from raising calves. I think that is an important point to be considered.

Mr. Sessions. You may have read the statement made by the Cattle Commission some years ago about two gentlemen, both well-to-do men. About the same time they conceived the idea of having a herd of cattle, and they both decided on the same breed. The farms were near together. They each built buildings of the same size and style of architecture, and bought their herds from the same parties. One of them raised all his own calves, and bought none from the outside. The other one, having abundant means, and desiring to outstrip others and to be able to tell a bigger story than anybody else, bought the best cows he could find, regardless of cost, bringing in foreign blood all the time. Four or five years ago one of the men found his herd in trouble, and sent for an expert to examine the cattle. Nearly every one was condemned and killed; they had tuberculosis. The other man thought he would have his herd examined by the same men. He did so, and every animal was free from tuberculosis. The man who purchased cows brought the disease into his herd. The man who raised his own cows escaped it.

Mr. A. M. Lyman (of Montague). A dozen years ago, when I was a young farmer, I listened to our ex-secretary and to Dr. Twitchell at the institutes and at the State Board meetings, and have tried to carry out the ideas I learned from them. They have been very helpful.

Years ago we invited Dr. Twitchell to speak to us on the subject of scoring a horse. We secured as good a horse as we could find, and had him on the platform. He did not score the horse as high as we expected. We did not think it was a perfect horse. We talked with Dr. Twitchell about it, and he said in conversation that he would score no horse over eighty-five. I think that was the number of points.

We say there are no perfect horses. No, we have not attained to perfect horses or animals yet. My disposition was to try and see if we could not better that, so that the horse could be scored higher. I hope we will all profit by these criticisms.

In regard to what Mr. Sessions has just said about raising our stock, I have raised nearly all the stock I ever had, and I have no disease among the cattle, and it is stock that other people want and are willing to pay me for.

Mr. N. I. Bowditch (of Framingham). There is one point Mr. Sessions touched on, and said he had not had experience in, and that was, in feeding ensilage in summer, — having enough left over to feed in the summer. I have done that for the last two or three years, and especially this last summer, and it was a great advantage. It was very surprising to me to see how the cattle would come in from the pasture and enjoy a feeding of ensilage.

Another point that I think is of great importance to farmers making milk, and that is, warming the water for the cattle. It saves grain. There are a number of tank heaters that can be bought for a small sum, and a fire can be built in them twice a day when the cattle are watered. The cows go out and drink and go in and chew their cud, instead of standing round shivering and letting their hair grow towards their horns.

Mr. W. B. Barton (of Dalton). Ensilage made of Canada peas and Japanese millet gives a food which, in my experience, is superior to the green crop.

My experience with cabbage is similar to Mr. Clark's. I raise them for the cows, and sell very few of them.

In regard to growing cows for the dairy; it has been my good fortune to grow what cows we have used for the last few years. I fear a good many of those who attempt to grow their dairies make the error of not continuing in one line of breed. They select a sire and use it one season, and when they breed another time they are very often apt to introduce a sire of another breed. I think that is a cause of a great many of our failures in breeding, — not continuing in the same line of breeding.

Gen. F. H. Appleton (of Manchester). There is a phase

in dairying that brings in cattle breeding. I think it is best for the farmers to raise their own cows. If we in Massachusetts could all do that, we would be well protected, and our markets would be clear of disease. But that is not so to-day. We are largely dependent upon the milk-yielding animals bred by others, and we run a certain risk, that has been referred to, in buying cattle bred by others.

This brings me to the thought of the value of our agricultural fairs and educational institutions in the line of live-stock breeding. I think we should make sure of having typical, first-class, A 1 animals, of the breeds that are apparently the most useful in the locality where the fairs are held. I have heard of cases where the management has selected animals to be shown, and guaranteed the owners certain sums of money, being sure that they were first-class in quality and educational in that respect. It does not shut out others. It seems to me there is a great deal to commend in that plan of selecting first-class animals as object lessons at fairs.

Mr. C. D. Sage (of North Brookfield). I believe what our worthy ex-secretary has said in regard to raising calves. I believe we should always try to breed to some purpose. The breed depends on the line of dairying we intend to follow. I want to repeat the advice I gave to a young man who has just been married, and bought a farm and started out to stock it. He asked me about buying the stock. I told him to buy a few good thoroughbreds. Get some good ones when you start, and raise the calves. It costs no more to raise the calves from a good thoroughbred cow, and you will be sure of getting a worthy animal; and you will be sure, if you make a good selection, to get a better price for your product.

I find that, while it is always well to give the calves a good start if you can, it is not always advisable to attempt to force. I have had more disappointments in expecting a fine cow from an animal that had been pushed than I have from calves that have been neglected and sometimes had been even stunted; they have often turned out better than cows that have been forced. If we keep them thrifty and growing, avoid all attempts to put on fat, we get a better dairy animal than when overfed. I think we get a better dairy

animal by raising them as farmers are apt to raise them than by forcing them.

Mr. F. L. Whitmore (of Sunderland). I have been reminded of what happened when I was in school. Our teacher said she had seen cows stand on an eminence and admire the landscape. She was asked if she did not think they would appreciate poetry.

My cows do not lap me, but they do occasionally offer to shake hands with me. I realize that no one man can do everything in this world. While it is good policy for some of you to raise your dairy cows, in the locality from which I come that theory would not meet with my approval. Our dairying is all winter dairying. We have no pastures. In the fall there are auction sales of cows twice a week, and I suppose a thousand cows are sold in Sunderland every fall to farmers who keep them through the winter and sell them in the spring; and to go to Sunderland and advocate raising calves would be like carrying coals to Newcastle. We have something else to do. We think we can devote our energies to something else, and our sympathies to raising boys and girls rather than to raising calves.

Dr. Twitchell. A successful dairyman will always sing a song to his cows when milking; but be careful you do not sing "Old Hundred" to a "Hallelujah" cow.

One thought, while speaking of breeding stock. I do not know what the custom may be here, but in my own State the fad of fancy markings still governs in the selection of males. They do not consider as they should what he represents. We should study the individual as an individual in selecting a male for breeding, and find what that individual represents in his ancestry. We should know the milk and butter production of his dam and grandam.

Mr. Whitmore. Returning home from a trip last week, I found a card bearing the name of A. W. Morse, inspector. One hundred is perfect; my score was ninety-eight. I believe Mr. Morse is here, and can explain. I concluded that any man who did not think my dairy was perfect must be lacking somewhere.

Mr. Lyman. We can hire our cattle pastured cheaper than we can own the abandoned farms. Speaking about one

hundred; perfection has never been attained. A fond grandmother, speaking enthusiastically of her grandson a few years ago, calling him by name, said, "He is over a hundred in most of his studies."

Mr. Sage. My friend Whitmore has raised five thousand dollars' worth of tobacco on ten acres. We know why he cannot afford to raise calves.

Mr. Burt (of Easthampton). There is one point I would like to bring out. I understand Mr. Sessions to say that if a heifer does not show up well the first six months, to throw her away. Is that right?

Mr. Sessions. As a rule, a good heifer will do well the first year.

Mr. Burt. A heifer that does well one year is apt not to do so well the next. We have been told to get rid of the cows that do not do well. In the course of nine or ten years there will be a year when a cow will not do well. Do not throw her away. I would not throw her away if she did not do well the first year.

Mr. Sessions. I might give a little leaf from the experience of my son, who raised cattle in Dakota. They ran on a ranch in the summer, and fed at the stack in winter. He brought twenty-five to Massachusetts; among them were eight or ten yearlings. The quarantine laws of the State required that they be tested. They had never been tied up. My son loves a cow as well as ever I did, and he used to go out once a week and call his cattle to him, salt them, and keep up their acquaintance. The cattle commissioner came to test the cattle. He had just been having a severe trial with some cattle from Dakota, and he expected a terrible time with these. He asked my son how he was going to get along with them, and he told him if he would let him have his own way there would be no trouble. The commissioner gave the permission, and my son went to the yard where the cattle were, and put his arm around the neck of one, talking to it and patting it while the commissioner injected the tuberculin. The same course was repeated with each one in turn, and the commissioner said he had never dealt with a herd of cattle with so little difficulty. They had every confidence in their owner, and would submit to

the work of a stranger without any difficulty when he was present. We should go to the pastures often, keep up the acquaintance, and thus retain the confidence of our cattle.

Mr. Isaac Damon (of Wayland). I would like to say a few words in regard to summer feeding of ensilage. I find it very helpful in some cases. In feeding summer ensilage, the best way is to have a silo built especially for that purpose. The custom now is to build round silos. One of my silos is a large cemented one. It is all right in cold weather. To have good ensilage in the summer, you need a silo for that purpose, and the cows will eat a good big feeding of the ensilage.

In regard to Holsteins, I might tell a little story about a cow I had, on which I made a milk record. I first commenced to milk the cow three days after she calved, and she gave fifty pounds of milk. We tried to see what we could do with the cow. I told my boy if he would take care of the cow he could see what he could do with her. He commenced to take care of her, and she gradually increased the quantity of milk for a few days, until she gave sixty-seven or sixty-eight pounds of milk. She seemed to hang there. As I had a neighbor whose cows had made large records, I offered the boy a premium if he would beat the neighbor. He took charge of the cow. We milked her three times a day, and gave her all she would eat. Among other things, we gave her milk to drink. When the boy would get almost through milking, the cow would turn, as much as to ask if she was going to have the milk to drink. Once a day we gave her the milk she gave. She gave ninety-three pounds and one ounce of milk in twenty-four hours. If the boy went anywhere on the farm, the cow would follow him. I think there is a great deal in the conditions surrounding them and in the way they are used.

Mr. C. E. Parker (of Holden). I would like to emphasize one point in the paper, and that is, in reference to having a supply of ensilage to piece out the poor summer pasture. It has been the most trying season I have known for many years. It so happened that a year ago I grew about ten acres of ensilage. My silo would hold only about seven. I filled that, and made a smaller one. I used the

ensilage from the smaller one first and emptied that, and in the larger one I had about ten or twelve feet, forty or fifty tons or more, left in the bottom. The first of the season, when the food was plentiful, the cows did not care for the ensilage; but when the feed became short and the dry weather stopped the growth of the grass, I took off four or five inches from the top of the ensilage, and commenced feeding that underneath. The gentleman says you need a separate silo. Mine was all right after removing the top. It was as good as ever it was. I fed from that all through the dry part of the summer, and it was a great help to me. I do not know how my cattle would have lived through without that feed that I had in my silo. This year I am in the same condition. I said I would not raise as much; but the grain was luxuriant and tall, and I had to remove the hay that I had put in the smaller silo and fill it with ensilage. I believe I shall do it next season. We can grow no food so cheap as we can grow corn. We can raise thirty to forty tons to the acre. It is the only way we can piece out our pastures, in my opinion.

There has been a great stress laid on raising calves. I do not believe a farmer who lives close to a city can afford to raise calves, unless he has extraordinary stock. Those who have abandoned farms and large pastures, where land is cheap, can raise stock. It is as good a business, perhaps, as they can go into. But the farmers who live close to the city do not practise it much. They want their feed for cows that are producing milk. They cannot afford to fool with calves.

Prof. F. S. Cooley (of Amherst). I did not come in here this afternoon expecting to say anything; but the thoughts of the meeting have suggested to my mind one or two things. The first is in connection with raising calves; replacing your stock by home-bred and home-grown dairy animals. To my mind, that is the proper way to go at this sort of thing. But to my mind, also, there is a much greater chance for selection than is at present exercised.

In Germany and Holland, the home of one of the finest breeds of dairy stock that we have, there is a rigid system of triple selection in operation. In the first place, practically or nearly all the male animals are destroyed, — that is,

they are fattened and sold as veal. Only a few of the most promising from the very best cows are preserved. Among the heifers, more than half of them are sold as veal. Perhaps about one-third, as I have been told, are reared and bred, brought around to milk. Another selection takes place after the first milking period, and only those that have, besides being well bred and well developed, given good account of themselves in the dairy, are kept and allowed to keep up the breed. In this way one of the finest breeds of dairy animals that we have has been produced. So, in the United States, if we would select the best, and the best only, after a little while we would have good stock and plenty of it. I believe you do not realize what an enormous chance for selection there is. I have figured out repeatedly, for my class, the possibilities in different families of animals along this line. For instance, take a single pair of cattle; if each female produces three other females, in the course of one hundred and twenty-six years there would be animals enough born the one hundred and twenty-sixth year to occupy every foot of land in the United States, including Alaska. Pigs multiply so rapidly that in twenty-five years you would have about sixteen pigs to the square foot over the entire country. Take the rate of increase ascribed to bacteria. Dr. Conn states that they multiply once in twenty minutes. In four days the entire ocean would be filled with these organisms. Now, we ought to remember this and take advantage of it, and not keep anything and everything, but only the best.

Another thing that occurs to me is, that very few of you know what your cows are doing. You do not keep records. If you weighed carefully night and morning the milk your cows produced, and took occasional tests, so as to judge of the quality of the milk, — if you keep account for a year, I think you would have some surprises at the end of the year. Some of the cows that started in so big would disappoint you when you got the average, and would, perhaps, fall behind some of the steady ones. Perhaps some of those that gave an enormous amount of milk would disappoint you when you came to the test, and you would find that some of the ordinary, moderate plodders were some of the best money-makers. I think it will pay you to take the weights

of the milk your cows give night and morning, and make at least six or seven tests annually from each cow; select those that bring in the most money, breed from those that are the most profitable, and build up your herd in that way.

Mr. Burt. Mr. Parker feeds ensilage in summer. We can raise all the feed we want green, and it seems to me it is expensive to put it in the silo.

Mr. L. C. Dresser (of Gardner). I have kept cattle for the last seven years and made milk for the market, and while perhaps I have not learned very much, what I have learned has been of value to me in the last few years. We have a large silo, and a year ago we raised a large crop of corn, more than we could get into the silo. I cut it and fed it out until about the middle of January, then I began to feed the ensilage. I fed the last the second day of September last, and I do not think I threw away half a cart load of ensilage. So far as feeding it green, it would be a great expense to me to do so; it would take a great deal of help to handle it every day.

In regard to raising calves, I have to manufacture between seven and eight hundred quarts of milk every day in the three hundred and sixty-five. If I undertook to raise all the calves, or all those I would like to, I would have so big a herd on the farm that I would not know how to handle it. I raise from twelve to twenty every year, from some of the best cows I have. As a rule, they are very much more satisfactory than those I buy. I bought some cattle in Brighton, and I got one of the best cows I ever had; others were not as good. With some we have taken a great deal of pains, and bought the male of Mr. Hood and paid a good big price, and raised heifers from the best cows I have, and the results have not been satisfactory. On the other hand, I got some cheaper animals by trading a horse for them, and among the rest was a yearling male. We raised a heifer from them, and we are milking her to-day. She is one of the best heifers we have raised.

I have one cow that stands at the farther end of the row, and every one who comes in says she is an old, homely cow. She has very long, large horns. That cow has been there for two years, and she has not been dry but two weeks in

the time. She came in last March. She gives twenty-two pounds of milk to-day, and is due to calve in two months. That cow was very poor at first. I paid $22.50 for her in Vermont. After I got her home, she looked so bad that I wanted to sell her for $30. I kept her three weeks, and she gave sixteen quarts of milk a day; and I have kept her ever since, and as long as she does as well as she is doing now I shall continue to keep her. She is not thin, but is coarse, and a plain-looking cow. You cannot always be sure what you are going to get when you raise animals, and not always when you buy.

Mr. Damon. I sell all my milk. I think heifers two years old will produce as much milk as the cows I can buy on the market. I think you can raise cows that will give better satisfaction than those you buy.

The Chair. I wish to announce that the lecture to-morrow afternoon by Dr. Conwell will be in the Methodist church. This meeting stands adjourned to 7.30 this evening, when the lecture will be delivered by Prof. William H. Niles, on "Holland and its people."

Adjourned.

HOLLAND AND ITS PEOPLE.*

BY PROF. WILLIAM H. NILES, MASS. INSTITUTE OF TECHNOLOGY, BOSTON.

In the selection of a subject appropriate for presentation here this evening, I have considered myself somewhat fortunate in having a familiarity with a country like Holland. You are all aware that Holland possesses many features of general interest and attractiveness. You are also aware that some of its characteristics are of special interest to those who are associated with agricultural industries. It will be my purpose this evening to address my remarks to all who are here, — guests, citizens of the town and agriculturists.

Will you now please allow your thoughts to wander with mine across the Atlantic, past the British Islands, and over the North Sea to its eastern shore. There we find a low, watery plain, which is known as "the Netherlands," that is, the "low countries." When this was first known, which was before the Christian era, it was a vast forest, thickly interspersed with waters and often widely submerged. History tells us that the ancient Romans doubted whether they should consider their possessions here as being land, or water. But the winds and the floods gradually destroyed the forests, and in time the country became a treacherous and almost deforested marsh. It was nearly two thousand years ago when a portion of a singular Germanic people sought a home upon one of the long, spongy islands, where they built some rude huts, and began a life that contained only the elements of civilization. The island itself was called Batavia, and the people were known as Batavians. Northward from them there lived a tribe with whom they were upon terms of friendly intimacy, known as the Friesians.

* Illustrated by sixty stereopticon views.

These two peoples have since been united into one race, the Dutch race, which has occupied the soil until the present time, but only by a constant and stubborn conflict with both nature and man. At times it has seemed as if the forces of nature were as deadly intent upon driving the people from the region as they had been upon the destruction of the ancient forests, while at other times it has appeared as if they had conspired with all that was cruel and tyrannical in their human foes to crush them out of existence. The resistance of the people, however, has been a noble one. Leaving their savage habits, they sought the advancing arts and culture of a civilized life. They kept back the waters of the tyrant sea by massive walls, they fixed boundaries to their vagabond rivers, dried up their interior seas, and thus they transformed that which by nature was only a worthless quagmire into one of the most fertile and productive countries of Europe. It is in Holland, the northern part of that Netherland plain, that we may to-day meet with the same peculiar Dutch people at home, and there it is that we may see the best evidence of their conquering industry. I therefore take pleasure in presenting to you this evening Holland and its people as the world's best example of the conquest of man over territory.

We will begin our more detailed study by examining a map which represents Holland with the North Sea upon the west, Prussia on the east and Belgium on the south. This country is situated in a latitude which is as far north as the eastern angle of Labrador. The entire kingdom is farther north than the northernmost extremity of the island of Newfoundland. In form it is extremely irregular. It is about one hundred and fifty miles across from north to south, and it is about one hundred and twenty miles between its most eastern and most western extremities of land. It contains an area of about thirteen thousand square miles, and it supports a population of about five millions of people. Its surface is that of a plain. There are no mountains in Holland, and but few hills, and these are mostly sand-hills, scattered along its coast, while there are a few in the south-eastern corner.

Upon a physical map the features which most attract our attention are the rivers. First there is the classic river of

the Rhine, the waters of which upon entering this plain seem as if they are in doubt as to which way they should wander. Soon after entering the country the river divides into two parts, one channel known as the Waal, while the other, flowing not far away, is known as the Leck. These branches make the two-horned Rhine of which Virgil wrote, and enclose the long, narrow island of Batavia, — the island upon which the early Batavians first made their settlement. Another branch turns northward to the Zuider Zee, while there is a channel now known as the Old Rhine, through which at an early time a considerable amount of water found its way to the sea. Coming from the south is the Meuse, or Maas, which, after meandering through the south-western portion of the country, discharges its waters westward through one of the mouths of the Rhine. While the Schelde is chiefly a Belgian river, its branching estuary and the associated islands constitute a considerable portion in the south-west of the kingdom.

If, now, you ask why I call your attention to these streams in detail, my answer must be that it is because from them we are to learn an early part of the physical history of the land. Had it not been for these streams, Holland would not have existed. In very early days a shallow sea occupied a very large part of the area now constituting the central and western portions of Holland. At that time there were dense and extensive forests about the upper waters of these rivers. The decay of the fallen leaves, portions of bark, limbs, and sometimes of the prostrated trees, produced a rich vegetable loam which was light and easily acted upon by the temporary and permanent rivulets, and transported as sediment to the larger streams. The rivers brought this material to the shallow sea of that early time, where it became deposited after the manner of a delta formation, which was built to the seaward. Thus the soils of the forests which had been transported and deposited by the streams were here converted into the early lands. All who are familiar with agriculture know full well that when streams bring such material as this and deposit it on low ground it becomes a very fertile soil. The progress which the Hollanders have made and the successes which they have attained in agriculture have had an

essential dependence upon the marked fertility of the soil, — a quality which it attained through the action of the streams, bringing a large amount of organic material.

When rivers overflow and deposit the sediments which they have brought, they often build the surface which lies immediately along the edge of the stream to a somewhat higher level than the surfaces which are farther away from the channel. For a time these natural embankments may serve to keep the current of the river in place, but when floods occur the rivers often burst through these and widely inundate the surrounding country. Thus it was with these rivers in Holland, for, while they were the agents in the production of the land, they also at times became the cause of inundating and sometimes of destroying considerable areas which had been brought under cultivation. It was therefore quite natural that the Hollanders should regard these streams as their natural enemies, attacking their farms and homes from the south and the south-east. It also appears that they took possession of the country before nature had half completed it, and in their struggle and conquest they have finished off the work to their own liking. The consequence of this is, that the visitor to Holland sees as many geographical features which are artificial as those which are natural.

But they likewise had another and a more stubborn enemy in the North Sea, which was attacking their territory from the west and the north-west. In this sea, with its frequent storms and conflicting tides, they found an enemy on the Netherland shores which was rarely quiet. At one time the lands had been built out, as I have described, beyond their present limits. Some portions which are now islands along the shore were then part of the mainland, and where there are now interior waters there were in many instances continuous lands.

During a great storm in the early part of the thirteenth century the waters were cast upon one part of the northern shore with so much force that they broke through and washed out so much of the loose land that the Gulf of the Dollart was formed in the north-eastern part of the country. Somewhat later another storm of great violence piled the waters

upon the north-western coast with such energy that they destroyed a very large tract of the country, and formed the Zuider Zee, where farms and villages had previously existed. At a still later date a terrific storm raged for many days, and then rushed into the land along the south-western coast with such disastrous results that lives were lost by the hundreds, cattle by the thousands and property destroyed by the millions. Previous to this time Dordrecht had been an interior city, but it now became a seaport, in consequence of the inroads which the sea had made upon the land.

The Hollanders were thus forced to suffer from the attacks of two great natural enemies, appearing upon opposite portions of their country, — the rivers from the south and southeast, and the North Sea with its storms upon the north and west. There was still another and perhaps a greater danger which threatened them in the occupation of the territory. The land was sinking beneath them. We well understand that some portions of our present coasts are slowly rising, while others are gradually sinking. But the movement is so very slow that when the shore is firm and rock-bound it makes but little difference during the period of a generation. This, however, was not so in the case of Holland. With a surface that was already too low, and with a soil that was very soft and easily disturbed, the subsidence of a very few inches was enough to involve the resources of a nation.

Under these adverse circumstances, it might seem as if the country and its people were doomed to destruction. We may well ask, Is there any power which can rescue such a land? The answer is, Yes; for there was a power that did save it, and that was human industry; and Holland stands as she does upon the map to-day, the best geographical monument to human effort the world can anywhere show.

The accomplishment of this result has been obtained by three processes. They first constructed and proceeded to maintain substantial embankments along the rivers, to keep them in their proper places. They also built strong and extensive dykes along those portions of the coast most threatened by the action of the sea. Finally, they pumped out the waters of the interior lakes and seas, and thus reclaimed the lands for agricultural purposes. The extent to which

the surface of the country has been transformed by these three processes is really surprising. A map showing the distribution of land and water as it was in one province, North Holland, in 1575, when compared with another map of that province as it was in 1875, shows that a great transformation of the surface was produced by the turning out of the water and the reclaiming of land in that part of Holland during the three hundred years. Since 1875 another large body of water has disappeared, with the exception of the portion used as a ship canal from Amsterdam to the sea. In the prosecution of these enterprises the people have labored under peculiar difficulties. In many places the land is so soft that any weighty construction placed upon it, without securing a foundation of long and closely driven piles, would soon disappear or become worthless, in consequence of the sinking. It has often been quite as expensive to secure the foundations as it has been to complete the rest of the structures. On the coast of Haarlam there is a dyke of granite which is five miles long and forty feet high, which extends two hundred feet into the waves, and there is not a stone quarry in all Holland. The stone of which this dyke was constructed was all brought over the sea from Norway.

In approaching Holland, from England, for example, the boat sails up some winding channel with the land on each side often lower than the water, and sometimes even lower than the keel of the ship. It is reported that in the province of Zeeland alone there are ninety thousand acres which are seventeen feet below sea level. Sailing onward towards some port which may be first indicated by spires of churches, we observe a marked increase in the number of boats until we enter the city by a harbor crowded with vessels of various descriptions. A map of the city of Amsterdam shows us that the location and the system of the larger canals is of fundamental importance in the general plan of the city. These canals are so arranged that domestic or foreign boats may not only sail into the city, but even through it, along the lines of the semi-circular canals which constitute the most important business thoroughfares of the place. Of course, such an alternation of wide canals and narrow roads is possible only in a country where the land is so low and

marsh-like that the canals may be constructed in any desired direction that will best accomplish the purposes of commerce. The several views show us what a busy aspect these canals of the city present. Other views in the suburban region and in park reservations show us that canals, when lined by trees, may constitute one of the attractive features of the country. Other views of canals in villages show us still more picturesque effects, especially where they constitute the principal lines of passage among streets of cottages, which, although simple in construction, are often attractive in form and neat in appearance. Some scenes as they may be witnessed upon these canals in winter show that skating in Holland is something more than a pastime, it is a common and popular means for going from place to place. The canals are so numerous and they so intersect each other and run in such various directions that they furnish an opportunity for visiting not only towns and villages but even the farms of the most rural districts by the use of boats or upon the ice.

What has been said of the multiplicity of canals will apply equally well to windmills. No Holland scene is complete without one or more of these. We sometimes see those which were of early construction still remaining in use and they constitute one of the most striking features in the landscape. Two views of windmills used for grinding grain, two of mills used for sawing lumber and two more used for pumping water give us some idea of the general appearance of many of these structures. While these mills are used for nearly all kinds of manufacturing purposes in towns and villages, it is to be particularly noticed that in the rural districts an exceedingly large number of them are used for pumping water. As used in that country, they constitute one of the most essential agencies for the drainage of the land. Six photographic views may illustrate for us how such mills are located, and how they may be employed in connection with the drainage of an old lake basin. In the middle of such an area one windmill pumps the water up to a slight elevation at the end of a canal which leads toward the edge of the basin; not far away another mill pumps it to a little higher level; and this process is sometimes repeated four times be-

fore the waters taken from the centre of the basin are placed in the larger canal surrounding it, which leads eventually toward the sea.

Some people have been inclined to ridicule the Hollanders for spending so much of their time in digging ditches, erecting dykes and constructing windmills; but we must remember there is no water power in Holland, unless it be what has been facetiously called "back-action power." Let us not forget that the Hollander never hears the sound of a running brook in his own country. Furthermore, in a land where there is little wooded territory and but small amount of coal, the chief article of fuel is the peat. When this is taken from the lower ground where it occurs, the water immediately gathers, and the owner has reduced the level of the surface of that part of his land which was already too low. We should be aware that on a plain over which the winds may blow with few obstructions, a windmill once set at its work will continue its action day and night, with very little attention except to lubricate it. It was the winds which were very largely instrumental in driving the waters over the land, but the sagacious Hollander has caught these winds upon the wings of his windmills and has made them pump out those waters, and enable him to reclaim the land for agricultural purposes.

A map shows us the position and form of the Sea of Haarlam. In 1840 it had a total length of thirteen miles, and in places it was nearly six miles in width. The winds were dashing the waves against its shores and gradually enlarging its area, while the health and safety of Haarlam, Leyden and Amsterdam were threatened. It took these determined people eight years to enclose this with a substantial dyke, and it required four years more to pump the water into the sea. In that twelve years they conquered an internal foe, and when all was completed they had added more than forty-four thousand acres to what is now one of the most fertile portions of their country. It has been said that whole flocks of birds which had made this lake their summer home came from their winter quarters and went screaming backward and forward, seeming to wonder whether they had lost their own heads, or the lake had gone mad. I assure

you that it is impressive to go through the basin of this old sea to-day, and find one hundred and thirty-three and one-half miles of hard, smooth roadway, and seven hundred and fifty miles of canals and ditches, large and small; and to think that only a few years ago this was the dwelling-place of crabs and eels, where we now behold eight hundred productive farms, each with its superb cattle and its comfortable home.

Another map shows us how the bottom of the lake was divided, according to the usual custom, by larger canals and sub-divided by smaller ones, until each farm is completely surrounded by a canal. A view shows us how the lands of the farm are divided by small canals into lots, and we see by the photographs used how the dairy men and dairy maids go to the pasture grounds, milk the cows, place the cans with their milk in the boat and return to the house. No fences are required around these lots, for the creatures cannot cross the canals except when they are assisted by temporary bridges. The Hollanders, therefore, are not so accustomed as our farmers are to go for their cows and drive them home; nevertheless they take good care of them. If the nights are cool and stormy, they may go out with blankets which they put over the cows after they have laid down upon the ground; and it is interesting to look out upon those broad, level lands upon a frosty morning, and see the bunches of cloth with cows underneath them.

The Hollanders are now entering upon a still more stupendous project of drainage. They are proposing to utilize a large portion of the area which is now covered by the waters of the Zuider Zee. The plan involves the construction of an immense dyke crossing the sea at its narrower portion, which may serve the purpose of holding the waters on the north in place, and also furnish a good foundation for a highway and a railroad which shall connect the western with the eastern portion of the country. It will be necessary not only to surround the southern part by a large canal, but also to establish and maintain channels of considerable proportion for the streams which must necessarily run through the district. It is estimated that the execution of this great undertaking will require thirty-three years for its completion,

that it will cost over one hundred and thirty-one million dollars, and that it will redeem seven hundred and fifty square miles from the sea. To the actual cost of construction there must be added damages which must necessarily affect some people, particularly the fishermen, who now obtain their living from the sea which it is proposed thus to drain. If this scheme shall be carried out, it will be the most gigantic work of its kind that has ever been attained.

[Views were shown of the curious milk cans and the placing of them in dog carts, taking a portion of the milk to a local market; and of a maid who had perhaps been engaged in the milking, and who was going with her dog and cart, with measure in hand, to market the product. Views were used showing the sea-beach, both as a fashionable resort in summer time and as a landing-place for the fishing boats from the North Sea. Views were shown of the fish women, showing their curious attire and their laborious way of carrying fish in baskets, either upon their backs or on their heads. There were also views illustrative of the farmers' wives and their daughters; and it was claimed that these were the women of high respectability, and often of enviable position in the society of Holland. Photographs of the present young queen and her mother also appeared upon the screen. Photographs of the noted works of some of the famous Dutch artists who have illustrated the scenes which they witnessed upon the streets and in the homes of the earlier people were shown by the stereopticon. While these were appearing upon the screen, with portraits of the people of olden type who were the early conquerors, the speaker remarked upon their love for home and their families, upon their quiet and often phlegmatic temperament, while at the same time they were highly industrious, coolly courageous, and especially distinguished by their indomitable perseverance.]

The ability which the Hollanders have shown not only to subdue the adverse forces of nature but even to so control them as to turn them to their own advantage in their struggle with their human enemies, was impressively exhibited at the time of the noted siege of Leyden. During a long and disastrous warfare, waged against them by the Spanish army

in the height of its military power, there came a time when the most important town which they had not captured was the old city of Leyden. This the army completely surrounded, and after planting their guns upon many forts, they waited to starve the people within Leyden's walls, for they well knew that they could not conquer them in an open fight. It was then that the people contributed their most dearly bought treasures, the women their heirlooms and the articles to which they were most deeply attached, for capital with which to open the dykes on the shores of the North Sea, and to equip a small fleet of boats to bring them food by sailing on the invading flood which they hoped might drown their enemies. When the people within the city had reached starvation point, the wind most unfortunately shifted and so drove the waters back to the sea that their friends who had started to sail on them over the land were left stranded in the mud. It was then that the people watched and prayed for what they had always before dreaded, — an equinoctial gale. It was this time a blessing to them, when it came with such great force as to set the fleet in motion toward the beleaguered city. Finally they were before the last great fortress, a citadel of strength regarded as impregnable. A dark and stormy night came on, during which there were many strange sounds. When the morning came, it was found that their enemy had departed during the night, in consequence of the invading sea. Thus Leyden stood and Holland was saved because those people which had reclaimed the land and cultivated the soil knew how to turn a raging sea into the line of warfare to fight a desperate battle for them. Such, my good hearers, are some of the characteristics of Holland and her people.

SECOND DAY.

The meeting was called together at 10.40 A.M., by Chairman WOOD, who said: Mr. J. Lewis Ellsworth, delegate from the Worcester Agricultural Society, will preside at the meeting this forenoon.

Mr. ELLSWORTH. The subject presented for discussion this forenoon is "Market gardening." The importance of this branch of farming is increasing every year. The demand for the product of the market garden is increasing, to keep pace with the large increase in population in our cities. It is my pleasure, ladies and gentlemen, to introduce to you a fellow townsman, one with whom I have been closely connected for a number of years, as our business is similar, and also in the society of which he is secretary, the Worcester County Market Gardeners' Association. He thoroughly understands the gardening business, taking the great majority of prizes of the Worcester Horticultural Society, and occasionally running down to Boston and taking the prizes from the horticultural society there. It is my pleasure to introduce to you Mr. H. R. Kinney of Worcester.

Mr. KINNEY. I do not come before you as a lecturer or as a college graduate, neither have I had the advantages of apprenticeship. What I have learned about vegetables I have learned at meetings of this kind, and from practice and from a practical application of all the knowledge which came within my reach.

MARKET GARDENING.

BY H. R. KINNEY, WORCESTER.

Before commencing to write on this subject, I looked over the reports of this Board, and found that market gardening and vegetable growing had been considered at length by several of the foremost growers and writers; and, while the conditions are continually changing, I think it would be time well spent for those interested in market gardening, to look over the reports for the last thirty years, at least, and I would call special attention to lectures and discussions as follows: —

Report for 1876–77, lecture by B. P. Ware. This lecture is very full of useful suggestions in preparing ground and in growing the more common farm vegetables.

Report for 1877–78, essay by W. D. Philbrick, on "Market gardening." This is accompanied by several drawings of interest to those who have never spent much time about the large market gardens; it also gives many details of particular interest to the smaller gardeners.

Report for 1888 contains considerable very interesting reading for the gardener. There is a lecture by A. H. Smith, who considers gardening in the Connecticut valley; and a paper by W. W. Rawson, who considers the subject from the point of the "Market gardener" proper. Mr. Rawson also has a lecture in this report on irrigation.

Report for 1889 contains a lecture by the late Peter Henderson, on "Market gardening as a business," and also many things of interest not only to the market gardener but to all who cultivate a garden.

It is much easier to speak on general lines, and look at our successes, and that would probably be acceptable to the majority of those present; but there may be some here who would like to get a new idea to carry home with them.

Market gardening in general is confined to localities near cities or large towns, and in the immediate vicinity of the large cities of the State it is carried on quite extensively, in fact, to such an extent that large quantities of vegetables have to be sent to the smaller cities and towns.

We have now reached what I consider the most important point for consideration at this meeting; that is, the supplying of the towns and villages in Massachusetts with vegetables. It is true that we cannot expect to build up large market gardens in the country, but has not the time come for the towns to supply themselves with vegetables? We would not suggest that every farmer go to raising vegetables; but it always seemed as though there was something wrong about raising vegetables around Boston, on land worth enough per acre to buy a good farm in the country, and then take them to the city, and ship them, often by express, to the country towns. We will admit that this is business for the railroads and commission men; but is it for the farmer, especially the small farmer? We are compelled to meet, in our local markets, produce from practically the whole world, and on what we can supply we save freights and commissions, which are no small items in handling perishable produce, and the markets would be supplied with better produce. I am always glad to see the necessities of life cheap, and the more the luxuries are brought within the means of the people, the better. But to do that the agriculturist should not labor for less, but should raise such crops as his soil and locality will produce, as cheaply as those who are supplying his markets.

Market gardening, as it is generally understood, requires considerable capital, and to make money in any business requires capital of some sort. It may be in the shape of money, knowledge or energy, — and a combination of them all, is all the better; but there is, perhaps, no occupation in the farming line where a man can get a better living, on a small area, than from the production of vegetables, and when you consider the expense as compared with that of dairying, it is probably no greater.

I cannot recommend green-houses for the small gardener, especially if he is located some distance from a large city;

and I have yet to see the small green-house that was really a success in the production of vegetables. In connection with sash, a small house may be all right. The number of sash that the gardener can use to advantage depends as much on the amount of fresh manure that he can get at a reasonable price — which we should consider about four dollars per cord, delivered — as anything. The cost of starting a hot-bed may be considered about five dollars per sash. While this would have put up a very good run a year ago, it is doubtful whether at the present time it could be done for that price. It would include fence, plank, sash, mats and shutters. The sash and shutters should be well painted.

Small gardeners are very apt to place a frame for their hot-beds on the south side of some building or wall, and leave it there for a permanent bed; but this is not practised by the larger users of sash, and has many disadvantages. The gardener generally sets his hot-beds in the open field. He first puts up a board fence, six or seven feet high, facing the south, and slanting back some eighteen or twenty inches at the top. The posts should be five or six inches through at the top, and set a good three feet in the ground. We hold the boards to the posts by two coach screws to each post. These screws pass through narrow cleats with a large washer between the cleat and the screw-head. The boards are taken down in summer and used to blanch early celery. We mark every board before it is taken down, and then, by using each fence by itself, there is very little trouble in putting it up again. We leave the cleats screwed to the posts, and seldom have to bore a new hole.

We set our plank farther from the fence than many, as we wish to have plenty of room to walk between the bed and our mats, when they are rolled. We set a line three feet or a little more from the bottom of the fence, and from twelve to fifteen inches above the ground, and, if possible, draw it tight, so as to give the bed as nearly an even fall as possible, if the land is not level, — and it is not well to have it exactly level, as the water does not work off so well, but we do not like to have it fall too much. If this line is drawn tight, and stakes put in often enough to prevent it from sagging, all that it is necessary to do is to set a line of plank the

length you wish the bed, — twelve inches wide and two inches thick are none too heavy. These are held in place by stakes about three feet long and three or more inches wide, sharpened and driven, two to the plank. The end ones should be nailed to both planks, and come to the top of the plank to break the joint. It is not so particular about the centre ones. Pieces of rough boards are all right for these stakes. Nine-penny nails are the best size to use for nailing the stakes to the planks, if you use stakes one inch thick; and by nailing through the stake into the plank it does not tear the plank to pieces much when taken down, as they are every summer.

Five inches seems to be about the right amount of fall on a six-foot sash; and the way we get it is to take a piece of board five inches wide and tack a cleat on one edge at the end, letting it stick out two inches or more beyond the board. By resting this cleat on the plank you have set, and letting the board drop its whole width, five inches, below the plank already set, and setting the edge on the south plank, all you have to do is to put the level on this board and bring it up to a level, and you have the fall with very little trouble. Eight or ten inch plank are all right for this side, and narrower will do. We have a mark on this board that we have to level with, so as to know just how wide to set the plank.

The next thing is to put in one end plank, and it should be put in as near square with the plank as possible; if it is not, the sash will run badly. We generally let it come above the other planks a little, thinking that it makes a tighter joint.

We now want half as many spreaders — that is, sticks to go between the planks, to keep them from shutting up — as there are sash; and it does not make much difference what they are, provided they are fairly straight and stiff. We find two by three inch spruce the most satisfactory.

The planks now are to be banked nearly to the top with loam, and the ground should be smooth, so that all surface water will run off immediately.

The ground in the bed should be forked up as fine as possible, and left soft and loose. Forest leaves are perhaps the

best thing to put in to keep the frost out, and if there is danger of mice, it might be well to let the ground freeze a little before putting the leaves in, and it would be a good thing to put in a little corn and smaller seeds, that had been sprinkled with poison while wet, so that the mice, should they find their way in, would not flourish. The bed is now ready to close up with the sash and shutters, and when the sash are all on, put in the last end piece. This work should be done before winter, and the bed can be filled at any time.

During the early winter there is little danger of getting in too much heat; we often use eighteen or twenty inches deep and six or eight inches of loam on top. During December and January the beds want to be filled within a few inches of the top of the planks, as the plants grow very slowly and the heat will settle considerably; but as the days grow longer, plants will grow much faster, and do not need so much heat, and must be set a little farther from the glass.

Lettuce is the one great crop that is grown under glass in winter and early spring; and to grow this to perfection, it is very desirable — and it seems to be almost necessary — to have a loose, sandy soil. My soil is too heavy, and I have tried a great many things to put it in good condition for this crop, but have never been able to get perfectly satisfactory results. Heavy manuring and stirring the soil help considerably.

Turnip radishes will grow on almost any soil, but long ones need a loose, mellow soil, and do not need so much bottom heat as lettuce or turnip radishes.

During March and April many of the sash are used for starting plants. Cabbage, cauliflower, lettuce and early celery should be sown by the first of March for the first early crop; some sow much earlier, and if the plants are handled enough and given lots of room, it may be all right to put them in early, but to reset two or three times and have only one or two hundred to the sash when they are ready to put out of doors makes nice plants, but they cost high, as glass and labor should both bring money at this season.

It is possible to raise fairly good plants by sowing thinly, we prefer in drills, and giving the young plants plenty of

air, and when they have three or four true leaves, set them in a bed about two hundred to the sash.

Tomatoes, egg-plant and peppers may be sown from the first of March to the first of April, and need more heat than the lettuce and cabbage; and the earlier planted, providing they are well cared for, the stronger the plant. I am planting my tomatoes later every year, and am usually better satisfied with those planted after March 20 than earlier.

While we usually keep most of our plants of this class in the beds until after the middle of May, it is not necessary to have the glass over them so long, as it is better to have them uncovered during the day, and the shutters are all right to cover them at night.

Gardeners usually want to get most of their glass over cucumbers, as the weather becomes warm; and to do this, beds are planted in March and April with beets, carrots, radishes and plants that do not need glass as the days become warmer, and after they get well started, the sash are taken off and the beds covered, cold nights, with shutters. The cucumber beds are set up the same as the bed for winter, without the fence; but it is not necessary to be quite so particular, as the weather is mild now.

After the planks are set, before the ends are put in, plough through the centre, throwing the loam against the plank; then throw out a trench about eighteen inches wide and some two and a half feet deep, — that is, from the glass. Throw the best of the loam against the plank, in the bed, and the poorer on the outside to bank it with. Put twelve or fifteen inches of hot manure in this trench, and cover with about six inches of loam, then rake the bed down so that the loam will come nearly to the top of the planks, and some ten or twelve inches below in the centre. This gives room to set quite large plants, and they can nearly fill the bed before they strike the glass much. By setting two or more runs near together, it is easier to water than where they are scattered; they should be four to six feet apart with me. I have heard of places where cucumber vines grew ten feet or longer, and under such conditions the beds would have to be farther apart. When the vines fill the sash, if the weather is warm enough, take the sash off and then take

down the plank. We often set the plank for a second run of cucumbers the same season.

It is quite important to have good cucumber plants, and we have had the best success by planting the seed in the bed or green-house, and transplanting very soon after the plants come up, before they get too tall, as they are apt to, soon, if the bed is warm enough to bring them up good. Then, when they have made two or three true leaves, reset and leave until they have started again, when we set them in four or five inch pots, one plant to the pot. The advantage of transplanting is to make the plant more stocky. They may not give so many cucumbers as plants that have been handled less.

The heaviest crop of cucumbers that I ever grew, the plants were set one foot apart, three to the sash; but we do not set so thickly as that, as a rule, thinking we get better results, usually, by setting them two feet apart. They want to be set in the centre of the bed.

We have not considered the water supply as yet, as I take it for granted that no one would think of using glass to any extent without some supply that could be depended on at any time. It makes very little difference where it comes from, but it should be clean, so as not to clog the sprinklers, and have head enough to make a spray, to be all right to use on beds and in green-houses. It is not usually necessary to water beds very much before March, when they are run all winter; but after this time they will need considerable water; and I think they often suffer at this season, as they must have a great deal of air, and the beds have not much water in them even when they feel moist, if the heat is dry under them. Early in the season it is well to water on a bright, warm morning, so that the sash can be off and let the leaves dry; but as the weather becomes warmer, we usually water in the afternoon.

There is another subject of importance to consider before we think seriously about crops, and that is, in regard to our storage capacity.

It is not that crops bring so much more during the winter and spring than they do in the fall, but during the fall the farmers many of them have a surplus, and they supply the

market to such an extent that the market gardener is not needed. In fact, he should be at home, and taking to market only such of his crops as are needed, while the larger parts should be put away in pits or cellars for winter sales.

With the large gardener the pit is perhaps the best, but for the smaller it is not so convenient, either to fill or to take out of, as the vegetable cellar.

The cellar costs more at first, but I think that a cellar twenty-five by thirty feet square, and costing probably three hundred or four hundred dollars, if it were well arranged, would be a cheaper place to store vegetables than a pit, everything considered. If one were to be used for several varieties of vegetables, it should be divided into several smaller cellars, so that each kind could be put by itself. They all want to be cool, but some want much more air than others. Such cellars should have pointed walls and cement floors, so as to be proof against rats and mice, and should be so constructed as to be easy to get crops into and out of. If they adjoin the wash room all the better.

I have used such cellars for the past few years, and have put some vegetables in pits; and, while we do not find the vegetables keep so well in the cellar as they do in the pit, under the best possible conditions, we consider them more satisfactory for us.

Beets, carrots and potatoes keep all right in bins; onions keep well in shallow boxes or on shelves; in small quantities they are handled nicely in bushel boxes not filled very full, can be handled very rapidly and do not take up much room. We find that parsnips and horse radish keep best in shallow pits; they do not have to be covered to keep out frost, — six or eight inches deep is all right. We usually store them in barrels, packed close, and a fresh sod on top. They will come out better late in the season than any other way I ever stored them, and are apt to keep longer than those left in the ground over winter.

Our cellars are eight feet deep, and the ones we use for celery have shelves four feet from the floor, so that we get in two stands over most of the space. The walks between the shelves are filled in solid full of celery when we harvest, to be used first. As soon as these walks are cleared out,

which is usually before Thanksgiving, we can get at any celery we want, or that needs to come out.

To give you my idea of a cellar of this kind, it may be well to describe one we made two years ago. It was made in quite a steep bank, and is twenty by forty feet. The cellar proper is only twenty by thirty feet, and a room ten by twenty feet, separated from the cellar proper by a double board partition. The walls for the cellar are ten feet high, laid with some mortar and then pointed. Two feet from the top the wall sets back a few inches, and the floor sleepers rest on this. The floor is of matched spruce boards, and has four scuttles in it, about two by three feet, the frames for which are raised six inches from the floor. We keep the floor covered with meadow hay, and cover the scuttles if need be.

The wall extends eighteen inches above this floor, and the plate sets on the wall. There is a double-pitch shingled roof over it. The floor is below the surface of the ground, and the dirt comes nearly to the plate. There are no windows in the cellar proper, but there is a large window in one end of the room overhead, and a door in the other, and there is a window in the outside cellar. The floor of the cellar is on a level with the driveway in front, and we drive to the back door, which is in the room over the cellar. There is no lugging up and down stairs. It is also possible to ventilate quite thoroughly, even in very cold weather. This is not a cold cellar in winter, but it is easier to keep at an even temperature than any cellar I have ever had before.

It may seem strange to consider storage before giving any consideration to growing a crop; but of this whole market-garden business there is nothing, perhaps, as well understood or as well written up as the growing of vegetables, especially the more common varieties, and I shall not spend much time on that part of the occupation; and it may be well to say a few words about soil and manure, before we consider it.

While there is no one soil that is good for all varieties of vegetables, most varieties will do fairly well on any good land; but having land that vegetables will grow well on is not the most important thing to consider in the ideal market garden, but rather a soil that will work easy, is deep, lays

so that the water will not stand on it, and is practically level. These are some of the most important points to consider in this connection.

All crops that are to be worked by hand should have the rows run with the grade preferably north and south. Mine we have to run east and west, and there is a considerable tendency to grow to the south.

If you have plenty of water at your disposal, a light, loose soil will grow vegetables of most varieties to perfection; and while the general belief is that such soils require much more manure than those that are heavier, it is very doubtful whether that is so in the average market garden, where the land is kept constantly under cultivation. The light soil is always in condition, mechanically, to grow a crop; all it needs is the fertilizing elements; whereas the heavy soil, in a few years of continual cropping, becomes so fine that it will pack together so hard as to choke root growth, and to obviate this the market gardener puts on very heavy dressings of manure, — not that the crop uses up so much, but on such ground the waste is so great.

This loss is similar to that found by the Minnesota experiment station, of which Voorhees says: —

"By the system of continuous cropping which is universally observed in the great wheat fields in the north-west, there were but 24.5 pounds of nitrogen removed in the crop harvested, while the total loss per acre was 171 pounds, or an excess of 146 pounds, a large part of which loss was certainly due to the rapid using up of the vegetable matter by this improvident method of practice. Whereas, on the other hand, when wheat was grown in a rotation with clover, the gain in soil nitrogen far exceeded that lost or carried away by the crop."

In this connection I quote from a lecture by Peter Henderson before this Board in 1889: —

"Twenty-five years ago the market gardeners of New Jersey, mainly located in Hudson County, grew better vegetables than the Long Island men; but their limited area of land, getting less and less annually, in consequence of the inroads made by buildings, does not allow them to give their lands the needed relief of laying a portion yearly down to

grass, so that their ground has become actually surfeited with manure; and for this reason vegetables such as cabbage, lettuce and celery do not now average as good as those grown on Long Island or other districts adjacent to New York, where the land is cheap enough to allow one-third to be put down annually with some grass or clover crop. I believe that, in a garden of fifteen acres, if one-third is laid down to grass each year, and the balance kept under the plough, the gross receipts will be greater and the profits more than if the whole fifteen acres were under tillage; for less labor would be required, and manure tells better on sod land than on land under tillage."

While we believe this to be true, there is a belief, in the country at least, that the garden should be in the same place every year; and that the reason the gardeners can grow better crops of vegetables than the farmers is that they continue growing on the same ground year after year.

Ordinarily speaking, manure in the market garden should be ploughed in, and for such crops as cabbage, celery, beets and spinach we do not consider it any advantage to have it rotted down; but, if it is necessary to use manure for growing such roots as carrots and parsnips, it should be fine and rotten, and any manure to be used on the surface should be fine. Generally speaking, we consider the deeper ground is worked the more manure it will stand; and I think it requires more manure to grow a crop on land that is worked very deep, ten inches or more, than on land not worked so deep. Where land is good and plenty, many varieties of vegetables can be grown to perfection on commercial fertilizer, and should be grown much cheaper and better than on the heavily manured market-garden lands; but to use fertilizer largely in growing crops it is very desirable to have land enough, so as not to be obliged to have more than one-half of it under cultivation. There may be some very loose soils where you can use fertilizers year after year, economically, and keep the land under cultivation.

To my mind, while fertilizer manufacturers may sell what they advertise, they give the man who does not know what he ought to have the best possible chance to cheat himself. If it is a fact that the best grades of fertilizer are made up as

they should be, then the lower grades are all wrong. If we consider that a good, general vegetable fertilizer should contain ammonia, 4 to 5 per cent; available phosphoric acid, 7 to 8 per cent; potash, K_2O, 7 to 8 per cent, — what are we to think of the low-grade fertilizer that is guaranteed to contain ammonia, 1 to 2 per cent; available phosphoric acid, 9 to 10 per cent; potash, K_2O, 1 to 2 per cent? Neither of the analyses are the extremes of most of the large fertilizer manufacturers, and one or the other is very much out of proportion. The first of these we consider a safe fertilizer to invest in for use in the vegetable garden, while we think that the latter would be very expensive. It seems to be almost a universal practice with fertilizer manufacturers to reduce the amount of ammonia and potash and increase the amount of phosphoric acid as they reduce the price. It would seem as though the phosphoric acid were the body of the fertilizers, and the ammonia and potash the soul. If that is so, there is not usually much soul in fertilizers that sell below twenty-five dollars per ton. Phosphoric acid is probably needed on most soils, and if we know to what extent, very well; if not, it is safer to use a more evenly balanced fertilizer.

We will consider the vegetable garden in a general way. Land that is to be used for the very early crops of spinach, beets and the more hardy vegetables, if ploughed in narrow ridges in the late fall, can often be planted in the spring, before the frost is all out. It will not work so well during the summer as land left until in good condition before working it, but will, *sometimes*, give an earlier crop. It is well to use a good fertilizer liberally, on these beds, even when ten or more cords of good manure were ploughed in, per acre, in the fall. We sow celery seed at this season, often with our beets, and sometimes get a good stand. When sowing celery in the open field we mix a little lettuce seed with it, so as to be able to see the rows as soon as possible. The celery comes slowly.

We find the Crosby Improved Egyptian beet the best extra early, but it is difficult to get true seed. We fail to get any that is satisfactory for less than one dollar per pound. The Detroit Dark Red, while not so early as the Egyptian, and making a much heavier top, is a good second early.

I cannot, as a rule, recommend new varieties of vegetables; but it would seem as though the Gradus, or Prosperity pea, had merits that would make it the early pea as soon as the seed came within the reach of the public, and I trust that it will not be mixed and spoiled as the Stratagem pea was. The peas are as large as the Stratagem, the pods are larger, and the quality is nearly equal to Nott's Excelsior. The vines grow about as tall as the Alaska, and, while they are frail, have yielded well with me.

While we are considering new vegetables, I wish to call your attention to the Golden Hubbard squash, — it seems to be of better quality, more productive, and earlier than the Green Hubbard. It is handsome, and grows to a nice size, — six to ten pounds.

To have a continuous supply of lettuce, it is necessary to sow the seed often. The first sowing should be at the time of the early beets. The Black-seeded Tennisball and Salamander are good, smooth-leaved, heading varieties. The Wonderful makes a very large, solid head that stands well. It has curly leaves.

Parsnips and horse-radish require the whole season to make their growth, and we do not put any other crop with them. Early carrots are sown with celery and the late crop after spinach.

There seem to be but three varieties of celery that we need consider. The Paris Golden is the fall celery, and is mostly used until the middle of November. After that time there is a call for something better, and the Giant Pascal is the most popular celery with us until Christmas, when the call is for Boston Market. This variety was largely given up by the Worcester gardeners a few years ago, but has done better of late and is planted quite extensively now. It is of the best quality, a fine keeper, and, as it does not grow so tall as the Pascal, it can be planted closer. Four to five feet between the rows gives plenty of room if the land is good, while six feet is none too far for the Pascal.

We set very little celery before the middle of June, and we expect good celery set as late as July 20. We intend to set the plants about six inches apart in the rows, and are perfectly satisfied if three heads make a bunch, — in fact we consider that the ideal size.

In regard to cultivation, do not wait for the weeds, but begin as soon after the crops are planted as possible, and keep at it. On good land it is but little trouble to go over it if there are no weeds, — and there will not be many if you begin early and go often. If they get a start we generally pull them and take them from the field. For working such crops as beets and carrots, we find nothing better when the plants are small than the Arlington slide hoe. But this will not work well unless the ground is in the best condition. Later, we use the Buckley wheel hoe. This has a large wheel and does good work, but is not made well enough, which is a very general fault with agricultural implements. For a hand weeder, we consider Lang's the best. The Planet, Jr., cultivator is an excellent one, and, with the pulverizer on, leaves the ground in ideal shape. We consider the landside plough the best in the market garden.

" Let them sing who may of the battle fray,
 And the deeds that have long since passed;
Let them chant in praise of the tar whose days
 Are spent on the ocean vast.
I would render to these all the worship you please,
 I would honor them even now;
But I'd give far more from my heart's full store
 To the cause of the good old plough.

Full many there be that daily we see
 With a selfish and hollow pride,
Who the ploughman's lot, in his humble cot,
 With a scornful look deride;
But I'd rather take, aye, a hearty shake
 From his hand than to wealth I'd bow;
For the honest grasp of his hand's rough clasp
 Has stood by the good old plough.

All honor be, then, to these gray old men,
 When at last they are bowed with toil;
Their warfare then o'er, they battle no more,
 For they've conquered the stubborn soil.
And the chaplet each wears in his silvery hairs,
 And ne'er shall the victor's brow
With a laurel crown to the grave go down
 Like the sons of the good old plough."

Mr. A. M. Lyman (of Montague). I have been very much interested in this very instructive paper, and I am rising here to say a good word for this market gardener, the

champion of Worcester County in that line. I was at his place at about the time he began on that rugged land, and have seen the possibilities to which he has attained. I have seen the persistency and effort he has put into his work. When you hear the lecture, you think how easy and nice that work has been. When you see him working on that rugged soil, as I have seen him, you will decide that it was not easy.

We have with us to-day parties who are very successful market gardeners in our Connecticut valley garden, as we call it. I refer to the Smith Brothers of West Springfield.

The Chair. We would be glad to hear from Mr. Smith of West Springfield.

Mr. Addison H. Smith (of West Springfield). Nothing was farther from my thoughts than saying anything to this company. We have done something at market gardening. We have done it along different lines from those pursued by my friend Kinney, and yet, as our friend has said, Mr. Kinney has worked hard and achieved success. Any of us who have been to the horticultural exhibits at Worcester have found that his fruits show what his works have been. We who are interested in agriculture, and particularly in market gardening, must have a definite line of work. Mr. Kinney has attained success and he has told us how he did it.

We have worked hard, but perhaps not quite so hard as he has, for our land was somewhat easier to till; we have worked hard and built up our business. It has been a matter of a great deal of trouble and thought, and yet it seems to me that results such as Mr. Kinney has had prove that the work is worthy the doing. With us this has been a trying year. We had difficulty on account of the dry weather in the spring, in getting our seed to germinate; but by a little replanting we succeeded in getting a good crop of everything save celery. Owing to the poor celery seed that was put out last spring, we had to buy seventy-five or a hundred thousand plants. The plants we bought were mostly hollow, and not worth anything except to suck cider through; and we do not believe in that kind of business. It has been a very serious thing, and it seems to me there is a problem for us to see that seedsmen are not allowed to send out seed that is worse than worthless. People come to me almost every

day as they ride pass, and ask me if I am not going to get in my celery. I say "No." The stalk is not good. Out of twenty thousand plants I bought I do not suppose there were fifty healthy plants. It seems to me the farmer is entitled to some protection from seedsmen.

With the exception of celery, our crops have been very good this season. We have in store now perhaps fifteen hundred barrels of cabbage. We have parsnips, onions and turnips and most all vegetables of that kind to carry us through the winter. We have some green-houses.

That brings me to another thing. We have with us a successful cucumber grower. He is a neighbor of mine, Mr. Brown. He raises cucumbers under glass and ships them to New York, and knows how to get twenty-five or thirty dollars a bushel for them. I think you would like to know how he does it.

Mr. Brown. We get the cucumbers and send them down there, and they bring the money. That is all there is to it.

Dr. H. T. Fernald (of Amherst). There are some points in connection with the very interesting paper which we have heard this morning that I would like permission to touch upon for a few moments.

A recent map published in one of our papers was an interesting study to me, giving, as it did, the so-called centres for different subjects, — the centre of population of the United States, the geographical centre, the centre of crime, of illiteracy. One of these centres, located not far from Erie, Pa., was the manufacturing centre. Far to the eastward of the geographical centre is the manufacturing centre. The editor, commenting on that point, said that this is but an indication of the concentration of manufacturing interests in and near the New England States. To my mind, however, it meant far more. Manufacturing means manufacturers, — not only owners, but workers. It means what we have all listened to for years, — the concentration of life in the towns and cities, which has led to the industry of market gardening; and the tendency to this concentration appears to be increasing with every decade, which increase means a continual development of this already large occupation.

Under such circumstances as these, we must recognize that the future of market gardening is a most important one. And as it grows we meet another problem, one already met in other lines, viz., a direct continuation of crop acreage. If I might illustrate my thought, it would be something like this: if an insect desires a particular food plant to attack (let it be the strawberry plant, for example), after the food supply for it and its descendants on one patch becomes exhausted, it will have to hunt to find the next area to supply it with that food.

We have a record of wheat fields running up to over twenty-five thousand acres in one strip. Allow an insect to start at one corner of that field, and it will need no time to hunt for the next wheat field. Such a field will allow the insect an abundance of food on which to grow and multiply and spread. In the same way the increased acreage of market gardens has provided a condition for a rapid increase in numbers of our injurious insect pests. We wish to increase our acreage of these crops without directly increasing thereby the rapid multiplication of insect pests, so that in time they will overwhelm these particular crops. This question needs careful consideration and study.

I have been very much interested yesterday and to-day to hear remarks such as this: "Now, this is the practical side of it. We will leave the theoretical side for the experiment stations and the college men." This is a pretty severe criticism, and, unfortunately, there is altogether too much truth in it, and I speak as a college man. There is too much theoretical work in the colleges and experiment stations of this country which has not yet been presented in a practical way for the people to use.

Now, I would like to say that the day has not come when theoretical work can be avoided. If we follow the life history of an insect, as has no doubt been frequently done before you, from the egg through the various changes until the adult is developed and has laid its eggs for another cycle of life, we must do that with scientific care; for the insect is continually struggling with its own enemies, which will seize any opportunity to attack and kill it. In just the same way

we must seize the opportunity in that life cycle where the insect is least protected to pounce upon it and crush it out of existence. This scientific work must precede the practical work. We must find the salient point at which it can be best attacked. While I yield to the justice of the criticism that I have heard more than five times in the last twenty-four hours, that too often this scientific work is stopped without being carried on to find the corresponding treatment for practical application, the salient point must be discovered first.

A practical treatment is what is needed at the present time. Look over the directions that have been given for the treatment of the cabbage maggot. I have read page after page on this subject. One method given is to take tarred paper and have a block made with three sharp edges and stamp out hexagonal pieces from that paper, and go through the fields of cabbage and carefully place these papers around the stems. That is an excellent remedy for the cabbage maggot, but I am ready to say that the man who discovered that remedy never attempted to cover ten acres of cabbages with it, or he would have given it up.

We want facts and methods that can be applied to twenty acre fields. The problem of finding remedies that are inexpensive enough to make it pay to use them is the problem of the future, in my opinion.

Question. What would you use to destroy the cabbage worm?

Dr. Fernald. Paris green.

Question. Would it not be dangerous?

Dr. Fernald. I have never learned that it has been found so. I am giving the experience of the larger cabbage growers of the Middle States, where they grow for the New York and Philadelphia markets. They do not say anything about it, but they use Paris green right along.

There is a repetition of broods during the year; the later broods coming from the earlier broods. If you reduce the broods to a few individuals the first of the season, you have practically nothing to deal with the last of the season. The first of the season you can use Paris green safely. You can use it even after the cabbage begins to head, because it

does not head in, it heads out. You can sprinkle the outer leaves and even the outermost leaves of the little head, for these leaves never become a part of the cabbage as cut for market. The leaves inside have never been exposed to the treatment with the poison. Arsenical poisons are not as dangerous as they seem to be at first thought, because the cabbage grows out and not in.

QUESTION. Did you ever feed the leaves to your cows?

Dr. FERNALD. No, sir; I do not keep cows to try it on. These leaves, after a few rains, have been analyzed, and even after a summer shower, and they could not get a chemical trace of any arsenical poison.

Mr. SMITH. I rise in all seriousness, because it is not a problem solved by us. Two or three years ago there were great quantities of grapes dumped in New York simply because they had been sprayed with something that was poisonous. The color of the grapes had spoiled the market for them. If it went abroad that we were using arsenicals on our cabbage, would it not, in the long run, very greatly cut down the sale of cabbage? I think people would use some other vegetable. I notice that the lower leaves of the cabbage are cup shaped, and you may go through a field of cabbage after a rain, and even several days after a rain, if the weather is cloudy, and you will find that these leaves are full of water. I do not know what is to hinder the arsenic remaining in these leaves, and thus making them dangerous for cattle, if not for people.

Ex-Secretary SESSIONS. This fear of Paris green for cattle is all moonshine and nonsense. In the gypsy moth work we had endless trouble at first from the fears of the people that the extensive spraying we carried on would injure cattle, injure hens and even children. People were very much afraid of it, and we had a great deal of trouble to convince them that there was no danger. We tried many experiments. Among the experiments, the director was accustomed, when he went about looking after the work, to allow his horse to feed under the trees where the spraying had been done, so the people might see that there was no danger from the Paris green. His horse did not show any evil effects from eating this grass.

Since I rose to my feet, it occurs to me that a gentleman is here who tried the most convincing experiments on that point. Mr. Kirkland made an experiment under our direction that I think will settle the matter in your minds.

Mr. A. H. Kirkland (of Malden). I will only say that under the direction of the gypsy moth committee I made a test in this matter of arsenate of lead, which adheres to the foliage in a much more marked degree than Paris green. Arsenate of lead contains arsenic. We sprayed a pear tree very heavily with arsenate of lead, used, I believe, at the rate of twelve and a half pounds to one hundred and fifty gallons of water, — ten times as strong as you would use Paris green. The spray ran down on the grass so that it was fairly white. We had hired an old horse at the Muller Brothers' tannery in Cambridge, where they kill horses for their hides. We cut the grass and fed it to the horse. We gave him two feedings a day, and kept him about a week. The people at the tannery said the horse was more frisky and felt better after eating the grass than before.

One word in regard to grapes. Dr. Goessmann analyzed some grapes under the conditions referred to. He found that a man, to eat sufficient grapes to poison himself, would have to take, if I remember rightly, several bushels at a sitting.

Mr. Kinney. There are two things to be considered in this connection. Where you have good apparatus and know your business, there probably is not the slightest danger in using the arsenicals. But the farmer who has nothing more than a pail and a whisk broom frequently gets the poison on in bunches. With the best apparatus I would not be afraid to eat anything that had been sprayed, because the particles are so fine. I know, if the poison is not put on with good apparatus, it is liable to be put on in bunches. With good apparatus it is practically harmless.

Dr. Fernald. One point raised by Mr. Smith deserves mention. He spoke of the feeling of the buyers of cabbage against the use of arsenicals. I would like to say that I am acquainted with gentlemen who are supplying New York and Philadelphia markets with thousands of heads of cabbage each year. They told me that they are continually

using Paris green or one of the arsenicals for this purpose, and they also told me that they did not say anything about it. That may in a measure explain why excitement has not already developed. The treatment has been in use for nearly ten years in the Middle States.

Another point I want to mention is this. I said, if you destroy the early broods of the cabbage worm, you do not need to use the later treatments. In other words, if the first treatment or the first two treatments are successful, you can stop using the arsenicals before the cabbage begins to head.

QUESTION. Would it be practical to apply Paris green to the cabbage with the same implements we use in applying it to the potato? Put it on dry?

Dr. FERNALD. I always like to mix it with lime. The fact is that the arsenic in Paris green is part combined and part uncombined. It is the uncombined arsenic that does the burning. It seems to be generally the case that where you can combine all the arsenic with lime, you reduce or entirely prevent the danger of burning. You do not get as certain results when using it dry as you do when using it in a liquid form. Still, I have seen it used in just that way on the cabbage on a small scale.

QUESTION. Isn't air-slaked lime a remedy for the cabbage worm?

Dr. FERNALD. I wish I could say yes. It is successful, perhaps, in some cases, but you cannot rely upon it entirely.

Mr. E. W. BOISE (of Blandford). Wouldn't you place more weight on the arsenate of lead for destroying the potato beetle than on Paris green? I have used it the past year with marked results.

Dr. FERNALD. The only reason I did not speak of arsenate of lead in reference to the cabbage was because of having in mind an extra precaution to avoid danger. Arsenate of lead has remarkable staying qualities; it will adhere to the foliage much longer than Paris green. Where you are dealing with potato tops, I should say it was very desirable to use arsenate of lead; whereas, with the cabbage, if the poison will stay on long enough to kill the first brood, that is all that is really needed. We do not want the poison

to stay on the cabbage, but want it washed off before the head comes to maturity. We have different ends in view with the two different plants.

Mr. Boise. Isn't arsenate of lead better for the potato, because it will not burn the top at all?

Dr. Fernald. I am a thorough convert to the use of arsenate of lead everywhere it can be used. I regard it as a better and more effectual substance to use, because it stays on the foliage longer, and because there is no danger of burning the foliage. The case of the cabbage is rather an exception, because of the peculiar conditions surrounding it. I would unhesitatingly recommend arsenate of lead in most cases.

Mr. Smith. I understood the essayist to say he recommended the landside plough for preparing a market garden. Wouldn't you recommend the use of the swivel plough?

Mr. Kinney. I have yet to see a swivel plough that would turn market garden land in good shape. Our land is worked twenty inches deep, and it is worked soft. There may be places where the swivel plough can be used to the best advantage, and I would recommend that every market gardener have a swivel plough. There may be one made that will work well. On all garden land that I know about the land has been turned largely in ridges. In Arlington on very large fields the crops are raised in ridges. In the Connecticut valley it is worked differently. I have not yet found a swivel plough that would do satisfactory work for me. The best landside plough I know is the National, which is made the same as the sulky. The sulky would do just as good work. Where you plough in ridges, the landside plough is preferable.

Mr. Smith. We have a swivel plough, but we have not ploughed ten acres with it. We think there is nothing better than a good chilled plough.

Mr. Kinney. I do not find many men who know how to plough a big piece with a landside plough. You should begin in the centre and plough around the centre. This gives you a furrow turned in from the edge all around.

Mr. Smith. How much income do you expect from each sash each season?

Mr. Kinney. I think five dollars a fair amount; some years it will be more, and some less. We run our sash all winter.

Mr. Smith. Is it the custom to run the sash all winter in Worcester?

Mr. Kinney. No.

The Chair. I see Mr. O. B. Hadwen in the audience, one of the pioneer market gardeners of Worcester, and we would like to hear from him.

Mr. Hadwen. I do not feel competent to instruct the market gardeners at this time. It is true that fifty years ago I indulged a little in market gardening, but the conditions existing then are so different from those of to-day that I feel as if I were a back number.

I have been exceedingly gratified with the paper that has been read. I feel that the market gardeners have been instructed and will know better what to do in their operations in the future than they have in the past. I feel also that the market gardening of the twentieth century will be entirely different from the market gardening of the nineteenth century. We are in an age of progress.

I am gratified that these gentlemen have been successful in market gardening, because I have known them from boyhood, and have known the difficulties with which they have had to contend. Our friend Kinney grows carrots that look as if they were all run in the same mould, and when put on exhibition at the agricultural and horticultural exhibits they invariably bring the prize. I was at an exhibition of a society once when Mr. Kinney came in to take his premiums. I noticed that they amounted to quite a large sum. I often ask impertinent questions, and I asked him what he was going to do with the money. He said he was going to use the money for a sinking fund to pay a part of the indebtedness on his estate. I could not have had a more satisfactory answer, because I knew he had commenced as a comparatively poor man, and he has proved a success in his vocation.

Years ago, when I was a market gardener, all I grew were peas and beans and corn and potatoes and beets and cabbage and a few of the common vegetables. I took these veg-

etables on my milk wagon, and supplied my customers. Of course I had them fresh and they brought a good price. I felt well satisfied with my vocation at that time.

The change that has taken place in the way market gardening is done is most remarkable. A great variety of things have been rejected. It is wonderful, and still there is in store for us a still greater change. I believe that each fruit and each vegetable is endowed with a natural period of life, and after it has had its day and generation it becomes unworthy of further cultivation, and new kinds must take its place.

Mr. Ethan Brooks (of West Springfield). Brother Smith said we ought to be protected in the matter of seeds from the seed dealers. There has been nothing said about gardeners raising their own seed, so far as it may be practicable.

Years ago, when I was raising vegetables, I raised the seed of the lettuce, for instance, and almost every plant I had would head perfectly. I selected the best possible plants and saved the seed from them, and year after year the crop improved. Just so with the cabbage crop. Thirty years ago I secured good seed of the flat Dutch variety. I have preserved that seed until now. I go through the cabbage field and select the heads that appear to be the most desirable, and pull them up. If the root is satisfactory, if there is nothing objectionable, I save the seed. In that way I am confident that I have improved that variety of cabbage. My neighbors have come to me to buy seed, and I have had calls from abroad for seed, and people from Westfield have come to me for plants.

One of my seed beds did not do well, and I found I was going to be short of plants, so I bought some from my neighbor. At the time my own plants looked inferior. About three out of four of the plants I bought proved worthless, — they had no head, — and three out of four of my own plants headed beautifully. They were raised side by side. I would like to ask Mr. Kinney if he raises his own seed.

Mr. Kinney. We do not, as a general thing. I intend to save my own cucumber seed, and, as far as possible, sweet corn, and I prefer home-grown potatoes, which is against the

general belief. From an experience extending over many years, I have yet to see the day when the results were as good from seed potatoes that were purchased as from those we could raise ourselves. The results cannot be the same with all growers. My ideal way of saving seed potatoes is to select them when they are dug, when you can throw out the poor hills.

In regard to other vegetables, I believe we get the best seed from California. Our climate is so liable to be wet, I do not think we can get the maturity or the germinant quality that they can in a climate where the seed can grow to perfection and then have six months to ripen. In the east, where we are continually cultivating the same ground, if there is any disease it is very liable to be in the seed. I am certainly a believer that very many of the plant diseases are carried in the seed. I think that is a thing that we shall find very much more general than we are at present ready to admit.

Mr. Edmund Hersey (of Hingham). I hardly agree with the speaker in regard to the potato. The potato is not a seed, it is a tuber. Whenever you get a seed that grows to full perfection, whether it be north or south, there you will get the best seed, because it is the strongest lived. With any seed that we can ripen on our own land, I believe it is best to do that thing. When you come to a tuber, the northern people evidently are able to grow a potato with a stronger life than we can generally do. They are able to keep it in their climate, and when we take their potatoes in the spring and plant them, they start off with a stronger life. I have no doubt that we can learn to keep our potatoes a great deal better than we do. We do not put our potatoes in a cool enough place. They lose a portion of their vigor before we plant them. After many experiments which I have tried, I find that potatoes raised in the northern portion of Maine will, as a rule, produce nearly one-third more when planted side by side with home-grown seed, or when every other hill is planted with potatoes kept as well as I can possibly keep them on my place. That has been my experience. Therefore, I take exception to Mr. Kinney's idea of keeping his own potatoes for seed, unless he has some peculiar place

where he can keep them, so that the sprouts will not start, and also a soil where he can grow them with eyes as large as they are grown in the northern part of Maine. You want a potato with a large, strong eye. You want also a strong life and a healthy potato. It is not the shape and the size so much as it is the life, simply because it is only a continuation of the old life. It is not the production of new life or of a seed. It is similar to the scion you take from one tree to another. If you have a scion that has a strong life, that is healthy and vigorous, you get a better tree from it than you will from a scion that has picked up a disease somewhere and is weak in constitution. You would propagate that weakness, and it is the same with the potato. A potato with a constitutional weakness will not produce more than two-thirds, if it does more than half, as much as a potato which has a good, strong life, and has no disease. It continues along in the same life. It is not the creation of new life. I think the farmers in general do not pay attention to this point in growing potatoes. They do not recognize that it is not seed they are planting. I have tried carefully for many years, and have not been able to change in the least the form of a potato by selection.

Mr. Joshua Clark (of Tewksbury). Those of us who attended the Farmers' Congress in Boston, and heard the very interesting paper on market gardening by a gentleman from Kentucky, will remember that he dwelt on raising potatoes. In Kentucky he said they could raise two crops of potatoes. He also said that from the second crop, from the potatoes not fully matured, they would get potatoes two weeks earlier. It would seem to contradict what Mr. Hersey has said.

Mr. Hersey. It is not a contradiction. If you take a round potato and do not cut it, you get potatoes about ten days earlier. You get potatoes from eight to ten days earlier by planting uncut potatoes. Why? Simply because by cutting the potato, unless you cover it with something, you are weakening its life.

I tried an experiment for ten years in succession, using the same seed, keeping it separate and carrying it along, and the tenth year there was quite a difference in the product

from the potatoes that had been cut year after year and those that were whole at the beginning and carried along. They had given up that vigorous life. They had weakened year after year, until the difference in the product was very marked.

I presume in that climate it was much better to have this second crop of unripe potatoes. They were probably small and uncut. If so, they would get better potatoes than from those that were cut and kept longer. The longer you keep a potato, the weaker it becomes. It loses its power to start new growth.

Mr. Kinney. Mr. Hersey and I exactly agree that the potato is a tuber and not a seed. But I claim if I grow the potato, dig it and sort it, I can get a more perfect tuber and a more perfect plant than I can by buying out of a car shipped here from Maine or elsewhere. I do not mean that a farmer should put his potatoes in a cellar and let them sprout all they want to. We have potatoes in as good shape as the men who buy from the car. My own experience is, if we take a perfect potato, grown from a perfect plant, and put it in the cellar and keep it in perfect shape, we think it will yield better than the potato we can buy. We have it more under our control.

Adjourned at 12.35.

Afternoon Session.

Chairman Wood called the meeting to order, in the Methodist Church, at 2.10 p.m., and said: I will introduce Mr. C. K. Brewster, the delegate from the Highland Agricultural Society, who will preside this afternoon.

Mr. Brewster. Ladies and gentlemen: A great deal has been said and written in the past few years in regard to the conditions of country life and the decadence of the hill towns of Massachusetts and of New England. At the meeting at Amherst, a year ago, a professor said it was one object of the agricultural college to infuse new blood into these hill towns. A magazine writer in the "Atlantic Monthly" of last April said that the hill towns were evolving a race of "poor whites." You have listened this week to

one of the representatives of these "whites," in the person of Professor Niles of Cambridge. You are soon to listen to another, in the person of Dr. Conwell of Philadelphia. The names of these distinguished gentlemen are above and beyond the reach of any magazine writer or of myself on the scale of learning, philanthropy and religion. It may be interesting to you to know that these two gentlemen were born and reared in the little town of Worthington, about twenty miles to the north of this town. It is an interesting fact also that at the commencement exercises at the Agricultural College last June the two Grinnell prizes were awarded to two Middlefield boys, a little town to the east of this, with four hundred and eighty-six inhabitants. It seems to me that in this the problem of evolution is being at least partially solved. I can suggest no better thing for the hill towns to do than to keep on evolving.

Many of you probably know that Dr. Conwell is at the head of the largest institution of its kind in this country, if not in the world. I thank God that, with all the cares that fall upon him in his great work, he forgets not the home of his father and mother, he forgets not the teachings of his boyhood and early life, he forgets not the hills from whence cometh his strength, and he forgets not the influence of the State Board of Agriculture of Massachusetts.

Ladies and gentlemen, Dr. Russell H. Conwell hardly needs an introduction to a western Massachusetts audience. I have the pleasure of presenting him to you as the speaker of the afternoon, upon the subject of "Country life."

COUNTRY LIFE.

BY REV. DR. RUSSELL H. CONWELL OF PHILADELPHIA.

Mr. Chairman, ladies and gentlemen: I have seldom in my life felt more conscience-stricken than at this moment, — when I began to appreciate the importance of this question and the magnitude of this subject, and thought how little time I had to put upon it, — no time until to-day, — and that I was obliged to drive here from Springfield since one o'clock, arriving five minutes ago, and must speak without my dinner. To come so suddenly upon so important a theme and to speak in the presence of so large an audience, with so little meditation, seems an almost unpardonable error.

I never had my attention especially called to this theme before, but, as I have meditated upon it in my ride from Springfield, it has grown to such a size that I shrink from contact with the boulder as it clings to the overhanging hills. I supposed that I was invited to talk to the Board of Agriculture, and I do not like to leave that idea. I think there are some things that might be said to the Board of Agriculture with profit also to the laymen who are not on the Board of Agriculture, — and the ladies who have not had that honor. Those of us who are farmers here in Massachusetts feel a great interest in our Board of Agriculture, and we have some things to suggest as to their proceedings, and some of these thoughts shall come from this farmer this afternoon.

The State Board of Agriculture I suppose was organized for the purpose of making the farms of Massachusetts pay. That is an important thing, but by no means the most important work of the Board of Agriculture. To make a farm in the interior of Massachusetts, with its barren hills,

pay so as to enable a man to support a family, send his children to college and give his wife a seal-skin coat, is a problem not yet fully solved. I shall not, however, take time to discuss farming or farmers. Yet, I start in with the very important conviction that the farms in the interior of Massachusetts can be made to pay, and in many cases they are made to pay. The only reason why any farmer on the hills of Massachusetts fails to make a profit upon his farm is because he does not adapt himself to the conditions of the farm and to the demands of the people at this time.

I was out in Indiana a little while ago, and was again introduced to a man whom I met there several years ago. He had been farming there. He was a Massachusetts man. That gentleman went to Indiana and undertook to carry on a farm, but could make nothing at it. Wheat was selling at seventy cents a bushel. Corn would not pay. Hogs would not pay. He concluded he was not fitted to be a farmer. He said he could not make the farm pay because of the close competition in all the staples raised on the prairies of the west. He went to Boston on a visit and there in Quincy market he saw what the farmers of Massachusetts ought long ago to have seen, — little cans of preserved gooseberries selling for sixty cents a pint. Sixty cents a pint! Said he, "That is all I get for a bushel of wheat. There must be something wrong about the gooseberries or about me!" The marketman assured him that there was nothing wrong about the gooseberries. He said to his wife, "Let's get back to Indiana as quickly as we can. Gooseberries grow wild on our farm. We have been grubbing them out. Let's permit them to grow." He went back to his farm in Indiana, planted not another grain of corn, raised no more hogs or wheat, but allowed the gooseberries to grow and cultivated them. Then he put in raspberries and strawberries and the small fruits, and to-day that man is the richest taxpayer in the whole State of Indiana. He raises no wheat, rye or corn. He has raised something native to the soil and cultivated it, and he sold his preserved gooseberries at seventy-five cents a pint. He canned them in the field within five minutes of the time they were picked. In the canned condition they

contained the freshness, odor and lusciousness of the native fields.

In the markets of Philadelphia and Boston and New York there is nothing that brings a higher price than preserved New England blackberries of the large, long native kind. People cannot get them at any price in some cities. Two years ago this summer a man came from New York to Middlefield to get blackberries. He selected carefully the largest black ones and canned them in the field without breaking them, and took them to New York. He sold the entire lot to one hotel at forty cents a quart. This is only a hint to the farmers of Massachusetts as to what wealth lies in the woods if they would cultivate the things that grow there naturally. When I undertook to raise blackberries on my farm in Massachusetts, I sent to New York State and bought bushes of large-sized blackberries. They were large the first year, and the next year they were small. I do not know as they are of any use at all now, except to shelter hens. If I had gone to the fields and cultivated the natural varieties until they reached a large size, I might have been a rich man by this time.

The farmers of New England are not now raising what the people specially need.

I know of a single farm that I used to own, which for twenty-five years, above all expenses and cares, paid fourteen per cent interest. You cannot find city investments that will pay anything like that. I am simply hinting at what it is not now my purpose to discuss.

The farms of New England can pay. I start out with that proposition. Farms, wherever they may be, if put in the right position and farmed on a large but economical scale, can be made to pay.

A few weeks ago I was in New York to deliver an address, and a friend invited me to his home, and he put maple crystals on the table for me to enjoy. Maple crystals; I inquired about them, and I found that maple sap makes a larger amount of maple crystals than of old-fashioned sugar, and they bring from seventy-five cents to a dollar a pound at the confectioners. When that man's patent runs out and you can make maple crystals, you will

get seventy-five cents instead of four or five cents. Why haven't you been doing it all these years? You have been saying, "The farms are running down, and nothing more can be done." There is certainly not as much done as might be done.

But the chief purpose, after all, of the Board of Agriculture of the State of Massachusetts is not to raise cabbages, or potatoes, or apples, or peaches, or pears, or to kill off the gypsy moths. All that is initiatory. While all these are included in their duties, and while it is certainly of great consequence to know how to raise cattle and to make butter and get it to market, yet there is an end beyond all these things for which the State appointed this Board of Agriculture. The people of the State do not care how many potatoes can be raised, if they are not eaten; they do not care how many berries can be picked, if no man needs them. They do not care how many cows can be raised, if the butter is not wanted. The great end of all these things is manhood, — the making of men. That old saying is as mighty now as it was when that New Hampshire man was asked what he could raise among those rocks, and he replied, "We raise men! We raise men!" That is the fundamental purpose of the Board of Agriculture, after all, to raise men! The raising of vegetables is simply a means toward a definite end. After all, the great purpose is to raise men. One Daniel Webster is worth more than all the potatoes you can raise in Hampshire County. One William Cullen Bryant is more valuable than all the corn you can raise in Hampden County. One great man whom the people rise up and call blessed is of more account than all the wheat combined in the graneries of Chicago. When you can raise a man like Senator Wilson in a little country town, and send him out to make nations free, then has the agricultural society which enabled him to live on that stony farm done a great duty.

I say, then, the chief purpose is to raise men. If that be the purpose, let us see what kind of men are raised in Massachusetts in the country districts. If I had only had the time, in the midst of the great multiplicity of my

duties, to have grappled with this subject, I would have enjoyed this hour because on the verge of it now I get hints of magnificent things I should love to utter on an occasion like this.

What kind of men have been made in New England? New England has in the United States Senate now sixteen Senators, while one State twice as large as the whole of New England has only two. The proportion of her influence in all the affairs of the United States is equally great. If you look back to the history of 1856–74, you will find that New England has sent out its men into all the great enterprises in the northern, middle and western States. The migration from the country towns has also come to Westfield, Springfield, Worcester, Boston and Salem. I have only time to hint at these points. There are sitting here people of Westfield, who were born here, who can count by the score men all around them now in the manufacturing business, and men who are now controlling the affairs of Westfield, who were born in some interior country town not far away. Their influence on Massachusetts is only a hint of their value made to the Board of Agriculture. The Board should see that the right kind of men are raised in the country. But these boundaries are too small between Connecticut and New Hampshire, between the Atlantic Ocean and the Hudson River. They are too small for the real Massachusetts. Massachusetts reaches out to the Pacific and way across the ocean, and has her men now fighting in the Philippines, where New England is leading our armies and navies. There are in the Senate of the United States fourteen men who were born on Massachusetts soil, and twenty-seven men born in Massachusetts are in the National House of Representatives representing other States. There are forty-one members of the United States Legislature who were born on Massachusetts soil or are sons of men born on her soil. When we think how wide is her influence, how great is her power and how national her force, we cannot over-estimate the importance of raising the right kind of men.

Westfield was a country town a while ago. You would be ashamed to say it is a country town now. Yet I hope

it will remain a country town for a good many years to come.

That distinguished son of Massachusetts now at the head of the statistical bureau was sent out to find out how many governors and representatives and senators had been born in New England. You will remember he found twenty-nine governors of States born in New England; thirty-two senators; eighty-four editors of daily papers; while of the generals in the army, five out of seven were born in New England. He found in the State Legislatures or holding some official position in the States, in one year two hundred and twenty born in New England, or sons of men born here. He found, holding the most important positions as ministers to other countries, five men born in Massachusetts. In the city of Boston there are one hundred and eighty-four manufacturers carrying on the largest business, and out of the one-hundred and eighty-four, one hundred and eight were born in the interior of the State of Massachusetts.

When you come to glance at what the sons of Massachusetts, bred on her farms, have done and are doing for the world, the importance of cultivating them becomes at once apparent.

I have just returned from a visit to Georgia, Alabama and South Carolina. I told those southern people that they ought to know better than to give the ownership of their new factories to Massachusetts men. They are, however, glad to get capital from Massachusetts. I told them they ought to be like Massachusetts men; building their own factories and keeping their money at home, and not send so much to Massachusetts to pay interest. When you think of the masses of people contributing their money from Kansas, Texas and South Carolina as a tribute to the manhood of Massachusetts, and think how rich you are and how the world looks to your capitol city as to a great financial centre, then its financial importance will become at once clear.

Two years ago I went into the west, lecturing. In Iowa I visited five colleges. Three out of the five had presidents from Massachusetts, and the other two were sons of Massachusetts men. At the head of the greatest institution in

Wisconsin was a Massachusetts man. The minister to Turkey in the same year was a descendant of a Massachusetts man. When I went to China, I found a Massachusetts man representing our nation there. In all the countries I have visited in my life there have come up Massachusetts men managing all sorts of affairs, from the taking the customs at the ports to the regency of a national university, as was the case in Japan. As philosophers, poets, statesmen, founders of new nations and new governments, that larger Massachusetts is so great that it is impossible for us to estimate it.

I went to the city of Grand Rapids, where I had occasion to visit their great factories. I found that one was owned by a man in Boston, one in Worcester, another in Springfield, one in Holyoke, another in Pittsfield. The great city, with all its enterprise, was very largely owned by Massachusetts men, and they are sending their interest money in a great tide this way. Grand Rapids is but a representative of a great many of the great cities of the United States.

A very amusing thing, to me, happened at Charlotte, N. C., two weeks ago. I was sitting in a hotel, and two southern men came in. Their southern accent was so broad that it was very interesting to hear them talk. After listening a little while, I was surprised to hear one say, "Well, we are carrying out our plans over in the Philippines, and this nation is getting to be a great nation." Then he took a paper out of his pocket which told what "the Yankees" were doing. I wondered how he would like that name. You know it is not many years since the southerners did not like that. I asked, "What Yankees are they?" And he answered cheerfully, "We are all Yankees now; the whole country is Yankee now."

The northerner has gone to the south and the west, and we are all proud to say we are all Yankees now. All through the south they are Yankees now; you cannot tell any difference between them. For this I am very thankful.

You look back to the source from which these men come. How are great men made? They are made by the air. You cannot make great men in a smoky atmosphere, where contagion dwells. You must make them in the pure air,

where every breath serves as a disinfectant, and brings vigor and life to the blood and calmness to the nerves and activity to the brain. Where will you find any air so bright and sweet as the air in the country towns in Massachusetts? Will you who live on the hills go to the city for a week? You will be so stifled that you cannot think clearly, you cannot eat comfortably, and you will have the dyspepsia and you will then begin to think that "all the country towns are going to the bad!"

Food makes men. It is vastly important what we eat, and the country towns of Massachusetts raise the most nutritious and healthy food raised on earth. Experience has shown that. You wives, didn't you ever hear your husbands tell about their mothers' cooking?

A scientific illustration shows the importance of good food. I think it was Professor Virchow of Berlin who took two kittens as an experiment in 1878. He fed them on different foods, and after feeding them for many weeks he approached one kitten and put out his hand to stroke it. It stuck up its back, spit and scratched. He went to the other one, kept in the same room; it stuck up its tail and rubbed against his finger with all the sweetness of domestic joy. They belonged to the same litter, were brought up in the same place, but they had been fed on different food. I have often said I can understand now why some men swear and some women scratch! You cannot make great men on miserable food. The kind of food to make imbeciles you get at the restaurants, at the stations, at many of our hotels, and in some of our fashionable homes, where, instead of having good food, the really good cook plays the piano, while a person who knows nothing at all about the chemistry of cooking is in the kitchen. Such food will not make great men. In the country, the wives and the daughters go directly into the kitchens and come directly in contact with the food, and know how to prepare the food which will make you happy and strong, building up muscle, brain and conscience together.

The water of the hill towns is clear and bright, like diamonds. It cometh from the fountains of the earth, with all the pressure of God upon it. It is filtered through God's

filter. That water purifies men. In our city hospital the greater part of the diseases are kidney diseases. Hundreds of men who apply to be taken at the hospital have kidney disease, and the consensus of medical opinion is that the disease is most largely due to the water they drink. We spend thousands and thousands of dollars in trying to patch up the miserable, down-hearted, sorrowful men, afflicted with this terrible scourge, kidney disease. In the mountains, where the water is purified by the light and winds, where it is preserved by the rocks, how little of the kidney disease you find! In Pennsylvania a comparison was made of the number of cases found in the country with the number found in Philadelphia, and it was as one to eighty-nine. There are eighty-nine cases of kidney disease in the city where there is one in the hill country.

Men are made by toil. As I rode into the town this afternoon I saw a young dude on the corner of a street smoking a cigarette. He was smoking up more capital in five minutes than he would honestly earn in five years. I wondered what sort of a man he would be. Will he be rugged and strong, clear in mind, with a deep and strong conscience? He will be the weakest of the weak; a contemptible dude all his life. Reared, perhaps, in some great city, he has come to visit your town. He sees the farmers coming to sell their wood, and he exclaims, "I am glad I am not as humble as these farmers who come from these country towns. I am glad I do not have to pile wood and chop it and drive those horses. I am very glad I need not expose myself to the winter season, to bring my lunch, go home late at night and have my supper at nine o'clock. I am so deucedly fortunate, don't yer know, to be able to have a cigarette at all." If he had brains enough to comprehend his position at all, he would understand that such work as he was doing would not make men.

Meeting the hillside and grappling with a plough makes men. How many young men there are who want to have an easy time! They are going into law or the ministry, — probably the latter, because they want an easy time, — where it will be so easy to get along. Of the thousands of students who come to me, more than two-thirds want

to take a short course in something that "will be easy." They want to take some middle ground that does not deepen or broaden the ideas. They want to get a soft place. And the young man who wants an easy place always has it, — usually in prison, where he ought to be. Easy places do not make men and women. A victory easily won is no victory at all. It is only a mighty victory, like the one at Gettysburg, where the cannon cracked, shots were fired and blood was shed. There are no victories in easy places, where men run before you shoot at them. I have always thought myself very unfortunate in my war experience. I was most always in a safe place. I see my comrades with scars on their faces, with the marks of war, limping still, and I was unfortunate in not getting into any such battles and winning victories as they had the privilege of doing.

Let the man who wants an easy time go to New York and keep a saloon. I do not know of anything that would be easier done, until he is killed in some of the riots. The man who means to be a true man grapples with things for the sake of grappling with them. The man on the hills in the country towns contends with the hard soil, removes the stones and puts in the seeds. The man is worth more than the potatoes. You had better stay here and be a man, than go west and have the malaria.

Sleep makes great men. Some of you remember the old cottage in the hills; you remember the old attic into which the snow drifted at night; and how after you slept there you arose in the morning, picked up your toes very carefully and soon found yourself down on the first floor beside the fire, with half your clothes in your hands. How sweet that sleep was! How delightful those dreams, when the rain was pattering on the roof! What would you give now for a night's rest like that? You made a mistake if you left that home and went to the city or to the plain. Oh, foolish poor farmer, who would give the health and manhood of the hills for the dollars of the city!

Great men are made in the country towns of Massachusetts. Great leaders of the nations, and especially the great men of the United States, were largely made by their

environment. The Swiss people practically rule Germany and France still. If you look at the history of the ancient days, you will find that when Babylon was taken the men of the rude country were the conquerors.

The high peaks make thoughts that are heavenly and meditation that is sublime. A man raised amidst a variety of scenery may enjoy a thousand things that other men cannot. I find that men are often made by the scenery amidst which they are reared. If you want your boy to feel ennobled, take him to the mountains and the hills, and then look down to some depth more terrible than those into which you intend him to descend.

Men were made intellectually in our district school systems. It is an important advance to have grammar schools, and high schools, and academics, and colleges, and universities; I think it is. But there are a great many disadvantages. The old-fashioned, liberty-teaching common school was the salvation of the State, and through the State the salvation of the whole country. The common school system began in Massachusetts, and it has been preserved through the country towns. It is the only place where you find children actually on an even democratic equality. There the rich and the poor meet together. The boys and the girls play together, and they learn the great American principle, that every man has the right to be the equal of every other man, if he can. When the common school system goes out of the towns of Massachusetts, I shall wait for the change in the whole government into some tyrannical form. In the common schools they learn liberty and equality; and a great deal more than even the children learn in the city schools, in some very necessary directions. You cannot judge a man's education by what he has read. Some men never went to school more than two years, and they know more in a minute than you and I with our college education will know in a week.

I have not time to do more than hint upon this. The common school is at the base of all political liberty. Preserve your common schools. You cannot preserve them anywhere except in the country district. Out in the suburbs of Westfield you will find some common schools still.

Keep them just as long as you can. The boys from those schools will come in and rule Westfield, in spite of the graduates from the high schools. They learn something besides their books, — something wider and far deeper.

In the country we used to have and have now in some places the old-fashioned country lyceum. You may talk about the modern school of oratory, you will never get a more perfect training school in public speech than the meeting in the little red school-house to debate living questions. That is the real school of oratory. If you do away with the country lyceum, you will have few orators left. You cannot make them in the city schools of hot-house elocution.

Then there is the town meeting. In all forms of government there is none so well adapted to the greatest liberty to the greatest number as the old-fashioned town meeting. It gives each individual a direct vote upon every question that interests him, and is the most democratic form of government. As soon as you adopt the city government, you elect representatives. If you had a city government in Westfield, and elected six men to the city council, six hundred thousand dollars might buy them all. But you cannot buy all the citizens of Westfield for that sum. It will be a dangerous condition when the old-fashioned town meeting ceases to be. The world is indebted to the town meeting for the best form of freedom which it now enjoys.

I look back through the years, and remember going to the old attic window at night and looking out into the front yard I saw a lantern flashing around there, and I saw a colored man. I had never seen but one before. My brother came and stuck his head up to the window beside me as we looked out. I could see my father hurrying about with a lantern. I saw another colored man whose name I afterward learned was Fred Douglass. He seemed to be very lively and very jolly. They put their horses in the barn. We understood what that meant. We got back into bed. We knew father would not be there the next day, and we would have to do the chores ourselves. Father would take the man as far as Conway, and some one there would take him and go to Canada. The first time I ever saw Fred

Douglass was when he was urging my father to go on to the next station of the "Underground Railway." Many of you have seen your fathers do the same thing. Slavery was done away with by the lyceum in the country school-house, where the evils of slavery were first openly discussed.

In the country towns the old-fashioned mills are preserved still, — the mills that our fathers used to put up on the little streams in the mountains, and in which they began to make some utensil not found in any other place. The people of the country towns have a wide experience in an untold variety of duties.

If a girl goes to the theatre in the city and is stage struck, foolish people will say to her, "You ought to go on the stage." But the people in the country, with their good common-sense, suppress the foolish, and encourage the solid and practical. There you get the straight-forward, square, moral, horse-sense of the world. An illustration flashes into my mind. I wanted to be an actor myself. Off in our country town we had a theatre in the church. They called it a "school exhibition," but we had a platform and curtains, and everything of that sort. I remember that I was very anxious to be an actor. I thought I would like to "strut and fret upon the stage, and then be heard no more." In this theatre I was to be the insane man. I was to rush in just as the man was proposing to the lady, and frighten them out of popping the question. I had to practice my piece when I went after the cows, and whenever I could get a chance. One day my father sent me to Huntington village with a load of maple sugar. The load was so high that I could not take the wagon seat, so I left it behind. When I went back I had to stand in the wagon.

The good horse jogged along and when I came to the woods I thought I would practice my piece, the first line of which was "Woe unto ye, daughters and sons of men." So I began as the horse was trotting along, "Woe," and that was as far as I went. No, that is not as far as I went, but as far as the horse went. When I said "Woe," the horse stopped and I went right over and landed on the shaft of the wagon, and the scar is on my forehead now where it brought the blood as I landed on the step and rolled over

into the mud. I went home and my father was frightened when he saw me, but when he found that I was not hurt he commenced to laugh and called one of the neighbors to look at me. He wanted him to see "a star actor." When the drama came off in the church I was not there. I knew the audience would all laugh at me. After that I never had any ambition to be an actor, — it was all knocked out of me as I fell over on my head. In the country towns such foolish ambitions are knocked out. The interlinking of desires and hopes, the open free acquaintanceship keeps men within the lines of common-sense.

There are just as grand men in the country towns to-day as ever lived there in all the centuries of the past. They are living there now.

It is natural for us to say that everything is running down. In 1702, two hundred years ago, Increase Mather, writing about New England, said, "New England, look to it that the glory be not removed from thee, for it begins to go. The glory of the world seems to be on the wing." That was two hundred years ago. Some of you have said the same thing within a week, but it means no more now than it did then.

A healthy farmer goes out and hoes on a row of corn, and while he hoes there comes to him feelings and thoughts sublime, high as Heaven, an inner experience as wide as the earth; and many a farmer has had more enjoyment in hoeing a row of corn than a city man has in a life time of sidewalk experience. The city laborer longs for an opportunity to be once alone in silent meditation. No man becomes great who does not take time for separate meditation. The city people have learned its necessity. They are going back to the country and buying land and raising the value of the property. They now spend their summers there. The country people will soon be mingling closely with the city people.

In the country the people have religious liberty. Half of them do not go to church, because persons in authority think that it does not matter what kind of a man they send there for a minister. The country churches are in many places in a state of decadence seemingly now. But they

will return. God has not forgotten His people, and has not changed His providence or His laws. We shall return to the religion and liberty taught in the country in the days gone by.

Religion must be taught, and must be taught to these country people, because when they enter the city such a strong tide of influence emanates from them. A man cannot be true to himself or his fellowmen until he has religion enough to do what is right in the fear of God and for the respect of his fellowmen. The hardy, hearty religion taught in the country towns must be preserved by the members of this Board of Agriculture, and I should have higher hope if all the members had been preachers in some country church.

Gentlemen of the Board of Agriculture, a voice comes from a great city, and it calls to you to-day in behalf of the people bleeding and dying in the slums of the cities. Gentlemen of Massachusetts and members of the Board, remember the slums of New York; remember the slums of Philadelphia! Go any night through those slums and see, lying in the darkness and rags, girls and young women. Hear the men swearing. Listen to the voice of the little child that reaches out his arms to Massachusetts and says, "Come to Philadelphia, New York and Boston, and help us." Listen to the young men and the degraded, as they call, "O men of Massachusetts! Come to us, and give us an opportunity to live purely and righteously." Listen to the voice of the people who are suffering for food in the great cities. Listen to those calling from their contagion of the small-pox and yellow fever, and help them. Listen to the call of ignorant men, who are asking for instruction. Listen to the people of the United States who have received their liberty from New England, and who expect you to preserve it. That voice pleads with you: "Gentlemen of the Board of Agriculture, if you love the poor, if you have a human feeling for your fellowmen, if you care for the enrichment of the lowly, if you seek for liberty for the people and for the progress of the nation, preserve in his integrity and in his intellectual superiority the man in the country town of Massachusetts now. Preserve him, help

him, inspire him, speak well of him. Let the country town in its smallness feel that it has nevertheless a great duty to perform in sending out hardy men to accomplish great good."

Think of Manila, of those in command at Santiago; think of that man reforming the whole country of Japan, and of the man who led Egypt into the path where it is to-day, — all from Massachusetts, or of Massachusetts parentage. Think of the universities, churches, charities, agriculture, commerce, manufactures, paintings, and all the diversified agencies of our civilization in which those country boys will be so potent, and, pressed on by the force of an awful responsibility, do what you can for them. Study potatoes, if you will; give your attention to beans, if you choose; but study them for their effect upon the men of the country towns who will be needed by the city and by the State and by the nation, yea, will always be needed by the developing world.

Vice-President Wood. I know that we all feel that this is no time or occasion to talk. What we have heard gives us food for thought. Therefore, I do not propose to burden you with a speech, but I want to make a motion in which I know you will be unanimous, and that is that we extend, Mr. Chairman, a vote of thanks to the speaker for this most extraordinary and interesting address.

It was voted unanimously to extend a vote of thanks to Dr. Conwell.

Adjourned at 3.15 P.M.

THIRD DAY.

Chairman Wood. Mr. Augustus Pratt, the delegate from the Plymouth County Agricultural Society, will preside this morning.

Mr. Pratt. Mr. Chairman, ladies and gentlemen: In the very able address we listened to yesterday afternoon we were pleased to learn from the orator what our State has done for the other United States and also for the world. We were proud to listen to him, and to think of our public schools, our colleges, and especially are we proud of the institution not a great distance from here, — the Massachusetts Agricultural College, — for the work it has done for the Commonwealth of Massachusetts and other sections of the United States, and I may say for other countries. Instructors and farmers have graduated and gone from the school to instruct and teach others, not only in this State but in the whole country. And to-day we are fortunate in having with us a gentleman from a sister State, and that State has had the benefit of our Massachusetts college in having a large number of instructors at present as well as in the past who have been educated and sent out from our Massachusetts college. Doctor Wheeler is among the number. I think certainly that the farmers of the Commonwealth, as well as the people, may feel proud of the Massachusetts Agricultural College.

I take pleasure in introducing to you Dr. Homer J. Wheeler of Kingston, R. I., chemist, Rhode Island Agricultural Experiment Station, a gentleman who pursued his studies at your college, and comes here to give you instruction this morning.

THE COMPOSITION AND ECONOMICAL USE OF COMMERCIAL FERTILIZERS.

BY DR. H. J. WHEELER, KINGSTON, R. I.

In these days of returning commercial and industrial prosperity, when the bulls and bears in the world's markets are wholly absorbed in their own mad rush for financial supremacy, and when the revival of business causes the commercial and manufacturing classes, glorying in the renewed independence arising from continual and remunerative employment, to forget that even their very existence is dependent upon the soil, and that the farmer is the backbone of the nation, it is more than ever fitting and necessary that far-sighted guardians of the nation's interests should foster agriculture, since it rests as the foundation of every other calling and profession of man. Yours is then a noble work, and whatever you do as a Board toward furthering agricultural education, whether through your Agricultural College, your experiment station or through your public meetings and farmers' institutes, must prove eventually a blessing to every resident, not only of your Commonwealth but of the nation. We must not forget that branch of agriculture represented by our great dairy and other animal industries; but underlying this is the primary question of the economical production of plants, involving as its fundamental feature the inseparable study of soils and manures. It is therefore a particular pleasure and with an appreciation of the high honor, borne out by the importance of the subject, to agriculture and to mankind, that I come before you to-day to speak upon the question under consideration.

In treating of the economical use of commercial fertilizers in the light of our present knowledge, one can hardly limit the discussion to potash, phosphoric acid and nitrogen, the

three so-called essential elements, but is forced to consider the subject from that broader point of view which recognizes as a fertilizer anything which tends to make the soil more fertile and capable of producing better and larger crops. Too many farmers are to-day buying fertilizers beyond their absolute needs, for the reason that proper attention is not paid to caring for their stable manure. Too frequently this is the result of carelessness and shiftlessness. He who has not learned that the chief value of stable manure lies in the liquid portion, and has not taken steps to avoid its undue waste is not, to-day, worthy of the title *farmer*. Again, the lazy man, who, to borrow a phrase from Professor Roberts, has not learned to "tickle the land" by tillage, but tries to compensate for it by buying commercial fertilizers, is no honor to the noble calling of agriculture. There are men of another class, who recognize that agricultural plants cannot be produced without drawing certain kinds of plant food from the soil; they forget, however, that weeds are made from the same sort of stuff, and must therefore be eradicated, to leave food for useful plants. Since Rhode Island is free from this class of farmers, presumably, they must all have moved over the line into Massachusetts!

As a result of the vindication of the much-abused Ville and the annihilation by Atwater, Hellriegel and Wilfarth of the experimental evidence which had been brought forward by Boussingault, Lawes and Gilbert, and Pugh, to prove that plants are unable to assimilate atmospheric nitrogen, there is now placed before the agriculturist the manner in which, through the aid of the legumes and certain other plants, he can unlock and draw at least a portion of the nitrogen supply for the farm from nature's vast aerial storehouse. The wide-awake farmer of to-day who would not be outstripped by his competitors should learn to know and utilize well the clovers, peas, cow-peas, soy or soja beans, vetches, serradella and other plants which may be profitably employed in gathering stores of nitrogen. He who has not already learned to husband his farm manure, to "tickle" his soil, destroy weeds at the right time and make use of leguminous crops, is not yet sufficiently out of the dark to be looking

about for commercial fertilizers. It may be thought that these remarks are not pertinent to the subject; yet it must be admitted that it is not an economical use of fertilizers to indulge in their purchase while still permitting direct and indirect manurial wastes to occur on every hand. The question now arises, whether, by husbanding all of the natural manurial resources of the farm, commercial fertilizers may not be discarded and permanent fertility maintained. Unfortunately, the experience of Europe proves the contrary; and, unless new and startling discoveries are made, the future of agriculture in the United States, as is to-day the situation in Europe, will be determined to a marked extent by the supply and economical use of commercial manures. To be sure, many a man who is fortunately situated near a large city, where stable manure may be had at a low price or for the hauling, will say that he has no use for and cannot afford to buy other manurial substances. Admitting that such may be practically the case, it cannot be denied that the great mass of farmers of a growing number of States are dependent to a large degree upon the use of commercial manures, and that these conditions are becoming exaggerated every year. We are thus brought face to face with the practical question of what to buy, in order to most cheaply and satisfactorily meet the peculiar needs of a vast number of plants and a multitude of soils, possessed of varying physical and chemical characteristics. Confronted with a question of such great magnitude, beset with difficulties most of which are as yet unsolved, it is only possible, especially in the brief period at disposal, to touch upon a few of the more essential features.

Potash.

Unleached wood ashes, which formerly constituted our chief supply of potash, are now not to be had in sufficient quantity to supply the demand for this substance. Such ashes constitute one of the safest and best sources of potash for the major portion of our crops and soils. Aside from an average of from 5 to 6 per cent of potash, they also contain approximately $1\frac{1}{2}$ per cent of phosphoric acid, 3 to

4 per cent of magnesia, and about 35 per cent of lime in the form of calcium carbonate. In regard to the phosphoric acid of wood ashes, there seems to be a lack of definite knowledge as to its assimilability, and it is possibly much inferior to soluble phosphoric acid (mono-calcic phosphate) and perhaps also to even other less valuable forms. While upon some farms and for certain crops the lime of the wood ashes may have little or no value, and with a few plants work positive injury, yet on many of our New England farms and for many of our important crops it imparts, frequently, more benefit to the lands than the potash which they contain. This great value of the lime has been abundantly demonstrated during the last three or four years in all parts of Rhode Island. Similar results have just been obtained, particularly in connection with the use of sulfate of ammonia, by Professor Phelps at Storrs, Conn., and by the New Hampshire station at Durham. Director Voorhees of the New Jersey Experiment Station bears testimony to similar experience in certain sections of his own State, and wonderful benefit is also reported to have been observed at Wellesley, Bolton and Westminster, Mass. In recent experiments conducted at the Rhode Island Experiment Station a gain of about 7 per cent in the crop has resulted from the use of magnesia; and it is not improbable that its use, particularly in connection with certain crops, may yet be found to result in more general benefit than is customarily supposed. Let us therefore divorce our minds at once from the unfortunate and fallacious idea that we must apply to our soils only the three so-called "essentials," — potash, phosphoric acid and nitrogen. Having done this, and then having examined the soil as to its probable need of lime and magnesia, and considered the crops to be grown, we are in position to know with some definiteness whether it is better economy to use wood ashes to supply our potash, or to depend upon the German potash salts, supplemented, as may be required, by lime or magnesian lime.

Another excellent though limited source of potash is the *ash of cotton-seed hulls.* These contain on an average about 22 per cent of potash, 8 to 9 per cent of phosphoric acid and from 9 to 10 per cent each of lime and magnesia.

Two other sources of potash should be mentioned in this category, namely, the *nitrate of potash* and the *carbonate of potash and magnesia.* The former, known as saltpetre and employed in the manufacture of gunpowder, contains about 14 per cent of nitrogen and 44 per cent of potash. Its cost is usually so great as to preclude its general use for agricultural purposes. The carbonate of potash and magnesia, containing about 21 per cent of potash and 19 per cent of magnesia, may be used as a substitute for muriate of potash wherever plants are grown whose quality is susceptible to injury by the chlorine of the muriate. It has not yet been generally introduced into this country, and has commanded too high a price to bring about its extensive employment. All of these sources of potash may be safely drawn upon for the growing of hops, sugar beets, a fine quality of potatoes, and other plants which may be injured by the use of muriate of potash or kainite; but for tobacco nitrate of potash would be objectionable.

High-grade sulfate of potash, containing about 48 per cent of potash, has been quite generally recommended in Europe and the United States for growing the crops just enumerated, since it is practically free from chlorine, though for tobacco it has not given as good results in the experiments conducted by the Connecticut station at New Haven, as certain of the sources of potash already discussed. Where potatoes are grown for the production of starch, the high-grade sulfate of potash is usually employed, since, unless applied the previous season, the chlorine contained in kainite and muriate of potash depresses the starch content. In the potato-growing sections of Rhode Island the farmers generally consider that a mixture of about equal parts of high-grade sulfate and of muriate of potash gives upon an average better yields than either one alone; and experiments at the Rhode Island station this season indicated that, so far as concerns yield, a mixture of the two or the muriate alone was slightly superior to the sulfate alone. Probably in a dry season the muriate of potash would have the advantage over the sulfate by virtue of its greater solubility.

For orchards, meadows and most garden crops the *muriate of potash*, containing about 50 per cent of actual potash or 80 to 85 per cent of muriate of potash, is considered the

most economical, since potash from this source costs from one-fourth to half a cent less per pound than in high-grade sulfate.

The only advantage which the *double sulfate of potash and magnesia* (containing about twenty-seven per cent of potash) may have over the high-grade sulfate rests in the magnesia which it contains, and, since potash is usually cheaper in the high-grade goods, the latter are more frequently employed.

Kainite contains about 11 per cent of potash, some of which is present in the form of sulfate of potash. This fact is unfortunately frequently made use of to convey the impression that it can be used in the place of the high-grade sulfate of potash, for crops where the chlorine of the muriate of potash would be objectionable. Such a proceeding is, however, wholly unwarranted, since this material contains, associated with the sulfate of potash, large quantities of chlorine in the form of muriate of potash, common salt and magnesium chloride.

Before proceeding, attention should be called to the importance of determinations of chlorine in connection with the analysis of commercial fertilizers. This is particularly desirable wherever the tobacco, hop or sugar beet industry is developed; and even in Rhode Island, where the potato industry is the chief one affected, the farmers who are looking for quality consider the matter of much importance. The necessity of this is particularly apparent in view of the deceptive way in which many manufacturers of fertilizers guarantee their goods. A large portion of the commercial manures on the market to-day bear the statement "sulfate of potash" or "equal to sulfate of potash," evidently for the purpose of making farmers believe that they contain more potash than is actually the case, or that the goods are practically free from chlorine. It is, nevertheless, a fact that the major portion of them contain as much chlorine as would have been the case had the muriate been the only form of potash employed in their manufacture. The sooner this vicious practice is dropped by the trade, the more quickly will the confidence of the consumer be gained and the consequent volume of sales increased.

Phosphoric Acid.

Phosphoric acid for agricultural and other purposes is now derived from various materials, though formerly the supply was practically drawn from bone.

Bone phosphate is a combination of one equivalent of phosphoric acid with three of lime. A similar combination of phosphoric acid and lime is found in the pebble and nodular phosphates of South Carolina and Florida, the phosphates of Tennessee and Pennsylvania, as well as those of Belgium, Algiers and many of those of other countries. Apatite differs somewhat from those just mentioned, and is generally considered as less assimilable.

Until of late bone has been almost universally considered as being infinitely superior as a phosphatic manure to any of the materials just enumerated. Recently however, pot experiments conducted by P. Wagner,* and others by Steffeck and Maercker,† have given indications that the phosphoric acid of bone meal, either steamed or raw, is practically no more assimilable by plants than that of certain finely ground mineral phosphates; and they conclude that the high value heretofore usually attributed to bone has been due as much, or more, to the nitrogen which it contains as to the phosphoric acid. In the earlier field experiments by Marek ‡ a striking advantage of bone meal over certain forms of mineral phosphate was but infrequently noticed. In a recent contribution to the subject by the veteran agricultural chemist, Julius Kuehn § of Halle, the ground is taken that upon light, sandy soils bone meal may be used even more effectively than superphosphates (bone, boneblack or mineral phosphate treated with sulfuric acid); while upon heavier, clayey soils, he places but small value upon bone as a source of phosphoric acid, as compared with superphosphate.

In Kühn's experiments with the sandy soil he employed potash as kainite and nitrogen in the form of sulfate of

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* Die rationelle Düngung der landw. Kulturpflanzen. Darmstadt, 1891.

† Ueber die Phosphorsäurewirkung der Knochenmehle. Berlin, 1895.

‡ Ueber den relativen Düngerwerth der Phosphate. Dresden, 1889.

§ Bericht aus dem physiologischen Laboratorium v. d. Versuchsanstalt des Landw. Instituts der Universität Halle. Dreizehntes Heft. Dresden, 1898.

ammonia, supplemented by applications of nitrate of soda made after growth had begun. A moderate application of lime as carbonate was also made in each case, in consequence of the fact that the soil was so deficient in this substance as to fail to produce peas, potatoes and oats, though still yielding rye and lupines. Considering the character of the soil, the moderate application of lime and the use of kainite and sulfate of ammonia, which would tend to aggravate the existing conditions, it is not improbable that the lime of the phosphate itself may have been as important a factor in helping the soil as the phosphoric acid. Dehérain, speaking of acid soils, calls attention to the fact that the acids may combine with the lime of phosphates, thus reducing their acidity, and rendering the phosphates more assimilable. The reduction in the acidity would be a potent factor in favoring the growth of many cultivated plants, — a fact abundantly demonstrated in the experiments at the Rhode Island station. It is probable, then, in Kühn's experiments, that some of the benefit attributed by him to the phosphoric acid may have been due to the lime of the phosphate. It must at all events be evident that the benefit to be expected from bone, even upon light and sandy soils, will vary with the chemical character of the soil itself. The greater the acidity, the greater will probably be the benefit observed from the phosphate applied.

Experiments with different phosphates which have been in progress at the Rhode Island station since 1894 bear upon this question. The plots are all manured alike, so far as concerns potash and nitrogen. One series was treated with air-slacked lime in 1894 at the rate of one ton per acre, none having been applied since. The total amount of phosphoric acid applied in the period has been the same upon each plot in both series. In the unlimed series the total yield per acre for the four years' hay crop (1896 to 1899 inclusive) was 1,295 pounds greater, where fine-ground steamed bone was used, than where floats (finely ground unacidulated rock) were employed. In the limed series the difference amounted to 1,488 pounds. A large application of nitrogen in the form of nitrate of soda

was made, annually, with the expectation that it would probably be sufficient to supply the needs of the plants. It is possible, however, that the nitrogen of the bone nevertheless exerted some effect; but, even if this were the case, the gain of the bone over the floats was small, amounting to only 372 pounds of hay per acre, annually, in the highest instance. The total net gain from the use of the floats, determined by deducting the yield upon the plots receiving no phosphates, amounted, in the case of the unlimed plot, to 8,012 pounds of hay, and in the case of the limed one, to 4,787 pounds. From this the effectiveness of the floats is strongly evident. The after-effect of the one ton of lime per acre in connection with the floats resulted in nearly doubling the yield of hay, while upon the plots receiving no phosphoric acid for the entire period the lime increased the crop of hay from 2,548 to 15,738 pounds. That the gain from the use of floats was so much less where the lime was employed was due, probably, to the absence of carbonate of lime in the soil, whereby the lime of the floats was directly helpful to the plants; and, furthermore, in the absence of the lime the solvent action of the soil upon the phosphate was materially increased. Another factor, however, probably exerted more influence than both of these combined, namely, the setting free by the lime of a large amount of phosphoric acid from the soil itself, which would of course reduce the apparent effect of that supplied artificially. In support of this, it may be cited that in a soil test by means of chemicals and Indian corn, conducted at the Rhode Island station, a most marked deficiency of phosphoric acid seemed to exist, potassic and nitrogenous manures proving of but limited value for several years. The plots were then limed at the rate of two and one-half tons to the acre, with the result that where only nitrogenous and potassic manures were applied the crops have since been excellent, due apparently to the liberation of phosphoric acid from the soil, notwithstanding the fact that but little if any phosphoric acid had been applied to the land for from fifteen to twenty years.

Sufficient has been said above to show the cumulative effect of applications of bone and of floats; but attention

should be called distinctly to the fact that, in taking up worn-out land, it would not be wise to depend entirely at the outstart upon these forms of phosphoric acid. In such instances, particularly if crops are grown which mature early, superphosphate should be used. Upon land leased for two or three years, if one considers the question only from the stand-point of the one hiring the farm, the same advice would apply. It seems probable, however, that, in renovating land upon one's own farm, the soil may be profitably stocked to a certain extent, preferably before seeding to grass, with bone or floats, depending upon their relative prices. As has already been stated, in the Rhode Island experiments a given amount of bone gave a greater yield of hay in a series of years than the same quantity of phosphoric acid as floats, this being due perhaps to some extent to the nitrogen of the bone. This is not enough, however, to warrant the use of bone instead of floats without first taking a look at the financial side of the question.

Let us assume that fine-ground steamed bone costs $23 per ton, and that it contains 23 per cent of phosphoric acid and 3 per cent of nitrogen. If we reckon the value of the 60 pounds of nitrogen in a ton of bone at 12½ cents per pound, the price of nitrogen in nitrate of soda, it would amount to $7.50, leaving $15.50 as the cost of 460 pounds of phosphoric acid. Assuming, again, that floats may be bought at $10 per ton, and that they contain 28 per cent of phosphoric acid, we find that in this case 560 pounds of phosphoric acid costs but $10, or at the rate of 1.78 cents per pound. At this rate, the $15.50 spent in buying the 460 pounds of phosphoric acid as bone would have bought 870.8 pounds of phosphoric acid in the form of floats, or 311 pounds more. The question cannot be dismissed here.

At the Connecticut station Johnson and Jenkins find that the immediate assimilability of the nitrogen of finely ground bone is less than 20, calling that of nitrate of soda 100. This is certainly a poor showing for the nitrogen of bone, and without doubt the cumulative action of a series of years would make a far better record, time being thus given for the bone to more completely decompose. In fact, other experimenters give it a value not far from 50, placing the

crop-producing ability of the same amount of nitrate nitrogen at 100. At the best, however, no form of organic nitrogen is equal in assimilability to nitrate nitrogen, even dried blood standing at from 76 to 90, as determined by various experimenters, in comparison with nitrate nitrogen at 100. Under the most favorable circumstances, then, it will be seen that in the financial comparison made above the bone was valued too high. It seems probable then from what has preceded that, at $10 per ton for floats and $23 per ton for bone of the assumed composition, in a series of years the use of the floats supplemented by nitrate of soda would often prove more generally economical than the bone.

Basic slag contains from 17 to 20 per cent of phosphoric acid. It is obtained as a by-product in the manufacture of steel from phosphate of iron. Instead of one equivalent of phosphoric acid being combined with three of lime, as in bone, it is in combination in the slag meal with four equivalents of lime. In this form, when finely ground, the phosphoric acid is generally considered to be more assimilable than that of floats or bone, approaching more closely that of superphosphate. Upon gravelly or sandy soils it would be expected to give even better results than superphosphates. Wherever the soil is acid it acts exceptionally well, because of its containing one-fourth more lime in combination with the phosphoric acid than is the case with bone and floats; and, furthermore, it contains even a further excess of lime uncombined with phosphoric acid, amounting at present in the best European products to from 8 to 9 per cent. Next to superphosphate, therefore, this can be classed as one of the best forms of phosphoric acid usually offered for sale. The price of this product has been not far from $19 per ton, though it should be sold, if manufactured here to any extent, at from $10 to $12. At $19 per ton, one would seldom use basic slag meal as long as acid phosphate is obtainable at from $13 to $14 per ton.

In the experiments at Kingston, R. I., already referred to, the yields of hay from the use of basic slag upon the unlimed soil amounted to 13,193 pounds, while with superphosphates they were as follows: dissolved bone-black, 10,017 pounds; dissolved bone, 10,717 pounds; and dis-

solved phosphate rock (acid phosphate), 11,254 pounds. The great superiority of the basic slag was unquestionably due in this instance to the favorable action of the lime upon the crop, — a function which the lime of the superphosphate, which is largely changed to land plaster (gypsum) in the process of manufacture, cannot effectually perform. In fact, the Kingston experiments bear out this conclusion most fully, as shown by the close proximity of the results secured with superphosphate to those with basic slag upon the limed soil, where of course the additional lime contained in the slag meal could not prove as effective in its influence upon the crop as upon the unlimed land. The basic slag produced 20,400 pounds of hay, while the results with superphosphate were as follows: dissolved bone-black, 19,838 pounds; dissolved bone, 19,281 pounds; and dissolved phosphate rock, 20,205 pounds. From this it will be seen that there was a total difference of crop, as compared with the dissolved phosphate rock, amounting on the limed land, in four years, to but 195 pounds of hay per acre in favor of the basic slag, while on the unlimed soil it amounted to 4,242 pounds, or over 2 tons, of hay. This not only illustrates in the most striking manner the point aimed at, but shows that upon acid soils where lime is deficient the lime of basic slag in its corrective influence upon the soil is a source of great material value to the farmer, amounting in this instance to over 2 tons of hay to the acre in the course of the four years.

Iron and alumina phosphate is probably but little known to the farming community, though, if the truth were known, there are many who use it as a constituent of certain brands of commercial fertilizer. This is the material known in Europe as redonda phosphate, where it is considered by many, even when treated so as to show by analysis much reverted phosphoric acid, as practically worthless, and a most dangerous adulterant of other phosphates. It is sometimes referred to as redondite. This phosphate is usually subjected in this country to a patented process, which renders a large portion of it soluble in ammonium citrate solution, as a result of which it is determined and classed chemically as reverted acid. After subjection to

this treatment it is usually designated as "ignited" or "roasted" iron and alumina phosphate, "roasted" redonda phosphate or redondite. It is also met with under the name of "concentrated phosphate." The raw or untreated material has been found in large quantities in certain fertilizers that have been sold in Rhode Island, and the treated material is doubtless employed quite extensively. This phosphate in its untreated state is generally considered as of no value, though recent reports from the New Hampshire station * would tend to show that it proved superior to the ignited product and to basic slag. Sufficient details are not given, however, to enable one to decide as to the probable correctness of these quite unusual conclusions. In the Rhode Island experiments there was little difference upon unlimed soil between the ignited and raw phosphate, the former yielding 4,930 pounds and the latter 5,043 pounds of hay. Where phosphoric acid was not employed, the yield was only 2,548 pounds, indicating some effect from the applications of both of these materials. In the limed series the raw or unignited iron and alumina phosphate appears not only to have been of no benefit but possibly to have worked injury. In the case of the "ignited" product,† on the other hand, it ranked slightly above dissolved bone, and very close to dissolved bone-black, the weights of the hay having been as follows: —

	Pounds of Hay.
Ignited alumina phosphate,	19,481
Dissolved bone,	19,281
Dissolved bone-black,	19,838
Without phosphoric acid,	15,738

The various results show, then, most strikingly, that the raw phosphate may be of a little service on a soil deficient in lime, and that liming such a soil does not increase the efficiency of this phosphate. On the other hand, while it is shown that the ignited iron and aluminum phosphate may be of some value on unlimed acid soil, its effectiveness, at

* Bulletin 59, pp. 189, 190.

† Merrill in experiments at the Maine station (fourteenth annual report Maine Agricultural Experiment Station, 1898, p. 72), calls attention to results secured by him, showing a similar value of the ignited product in connection with grasses, while with other plants its action was not so satisfactory.

least in connection with grasses, may be wonderfully increased by liming, so that it ranks close behind, if not quite equal to, the superphosphates.* It is probable that this experiment will throw some light upon some of the conflicting data and opinions now on record regarding this phosphate.

Superphosphates. — A superphosphate is essentially bone or mineral phosphate, treated with sufficient acid to combine with about two-thirds of the lime, leaving the other third in combination with phosphoric acid in a condition so that it is soluble in water. In this form it is customarily called soluble phosphoric acid. So far as concerns all of these dissolved phosphates, the data at hand indicate that, when properly manufactured, the phosphoric acid dissolved from the superphosphate by water is equally valuable, no matter from what it is derived. In case an excess of sulfuric acid is used in the manufacture, the acidity may be so great as to injure plants to some extent for a time, at least, and hence the phosphoric acid would be prevented from performing its function normally. Such a result should be laid at the door of the sulfuric acid, and not to the inefficiency of the soluble phosphoric acid (monocalcic phosphate). Barring sandy and gravelly soils, particularly when they lack carbonate of lime and exert an acid reaction upon blue litmus paper, and barring soils of even other character which may be acid, superphosphates may be considered as being the quickest-acting and surest form of phosphoric acid to employ, wherever crops must be pushed to maturity rapidly; or where the natural period of growth is limited, and the soil has not been well stocked for several years previously with dressings of floats, basic slag undissolved bone or mineral phosphate of similar character.

Enough must have been said in this discussion to bring out in the strongest light the influence of the physical and particularly of the chemical character of soils upon the action of various phosphates. It must be obvious, in view of the probability that large quantities of ignited alumina

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* Andouard (Annales Agron. 21 (1895), pp. 171–181), who experimented with a soil containing carbonates of lime and magnesia, obtained good results with this phosphate in the case of several kinds of plants.

phosphate find their way into the goods of certain fertilizer companies, that it is no unimportant matter to the farmer whether or not his land is acid and lacks carbonate of lime, and is, therefore, in condition to make the best use of the fertilizer which is applied.

Before leaving this question, attention should be called to the fact that all plants are not alike in their ability to utilize mineral phosphates,* certain of the leguminosæ, according to Prianichnikow, possessing this power in a much greater degree than the cereals. Interesting and valuable data in this connection have been obtained by Dietrich, in his study of the action of various plants upon pulverized rock. That various soils act differently as solvents of phosphates is a matter of common scientific knowledge, though it has been strikingly brought out by that veteran French chemist Dehérain, and by Prianichnikow.

Realizing that it is the custom of some to present everything to the farmer as settled fact, it may be a question if it is not better to occasionally remove the screen, particularly before a body of men like those in our audience to-day, and show that those who have studied the question of phosphates most deeply still have manifold problems to solve. It would seem to be important to call attention, also, to the necessity of investigating not only the action of all kinds of plants upon the different phosphates, but also the chemical character and solvent action of soils themselves. Random comparative trials of phosphates, reported without special reference to the plants employed nor to the chemical reaction and character of the soil, as is too frequently the case with those who do not understand or appreciate the full significance and bearing of these factors, are not calculated to result in much of permanent value. It would seem important, therefore, that our progressive farmers should understand something of the intricacy and far-reaching import of such inquiries, in order that they may have patience to wait for results. So long as the community expects experiment

* Compare Merrill, fourteenth Annual Report Maine Agricultural Experiment Station (1888), p. 74; also Schreiber, Revue General Agronomique, 1897, abstract in Biedermann's Centralblatt 26, pp. 802-805; and Prianichnikow An. Agronomique 25, No. 4 (1899), pp. 177-187.

station workers to reel off investigations, which farmers stand ready to measure with the yardstick rather than by weight, much of our so-called agricultural investigation will continue to be sneered at by the scientists of Europe, because of a vain attempt to satisfy an immediate popular demand by the appearance of doing something quickly, with the unavoidable result that the deeper problems that must be solved to insure the permanent progress and elevation of agriculture remain practically untouched.

Nitrogen.

Of all the sources of nitrogen that are employed in agriculture, the nitrates, such as *nitrate of soda* and *nitrate of potash*, are considered as the most readily assimilable, and with but few exceptions the most efficient. Nitrogen in this form can be immediately appropriated by plants. Next in order stands ammoniacal nitrogen, familiar to all as *sulfate of ammonia*. While there is considerable evidence at hand to show that plants may appropriate some nitrogen, as ammonia, without its first being transformed into nitrates, yet practically most of it is thus changed before it enters the plant. This transformation involves two stages. The first is that known as the nitrous fermentation, by which, through the activity of certain micro-organisms, the ammonia is changed into nitrous acid. The second, it has been claimed, may be the result of purely chemical processes, but is probably usually brought about by another kind of micro-organisms known generally as the nitric ferment. Though these changes are induced by the aid of organisms so small that they are only visible by the aid of the most powerful microscopes, yet they are so numerous that they can, under the most favorable circumstances, readily change ammonia into nitric acid much more rapidly than plants can take it up. During the progress of these changes some nitrogen is said to be lost and probably a small portion is transformed into organic matter, forming a constituent part of the organisms by whose activity the transformations are effected. These, in turn, probably change into what is classed as humus, in which condition the nitrogen is only slowly changed back again into a readily assimilable state.

Owing to these losses and transformations, it is now generally considered that the efficiency of nitrogen in the form of sulfate of ammonia is only about nine-tenths as great as that in the form of nitrates; so that, for all purposes where the nitrate suits the peculiar needs, sulfate of ammonia would not be substituted for it until the price of nitrogen in that substance has dropped to a point somewhat below the price of nitrate of soda. In using the two compounds, it should be borne in mind that commercial nitrate of soda contains about 15.5 pounds of nitrogen per 100 pounds, while sulfate of ammonia contains 20.5 pounds. For this reason, 76 pounds of sulfate of ammonia may be used in the place of 100 pounds of nitrate of soda, or 132 pounds of nitrate of soda may take the place of 100 pounds of the sulfate of ammonia, without materially changing the quantities of nitrogen employed.

In choosing between sulfate of ammonia and nitrate of soda as a source of nitrogen for our crops, there are still other factors to be considered. If one employs sulfate of ammonia, continuously, on soils which are somewhat acid and consequently deficient in carbonate of lime, the conditions become more and more aggravated, until the material, instead of serving as a valuable manure, becomes a veritable poison. An instance of this kind was recorded by Professor Sanborn in the early history of the New Hampshire station, then at Hanover. At Abbott Run, R. I., upon the third annual application of sulfate of ammonia the crop began to fall off noticeably. At Hope Valley, R. I., the crop fell off materially the second year, while a positive poisonous action was noticed the third year. At Kingston, R. I., the sulfate of ammonia exerted a poisonous action the first season. Certain European experience points also to a marked inefficiency of sulfate of ammonia upon certain soils, and an instance of this kind is also on record near at home, the same having been observed at North Hadley, in your own State. The value of lime as a corrector of such conditions was brought out simultaneously by Wagner and Dorsch in Germany, and at the Rhode Island station in the former instance in a trial of a single variety of plants, and at Rhode Island with thirty-eight different varieties. Professor

Phelps has now met with a similar experience at the Storrs station in Connecticut, the corrective influence of the lime applied being most marked, in the test of the past season. Should the price of sulfate of ammonia drop at any time much below the price of nitrate of soda, this material will in all likelihood find its way extensively into our commercial fertilizers, as it does into certain mixtures so widely used in Europe at the present time. If such should be the case, it will behoove the farmers of certain parts of New England to pay more attention to the lime requirement of their soils than would otherwise be the case.

Having spoken of the tendency of sulfate of ammonia to seriously aggravate the condition of acid soils or those deficient in carbonate of lime, it should be stated that nitrate of soda has the opposite tendency, the residual soda left in the soil after the removal of the nitric acid by the plant tending to counteract, though in a limited degree, the prevailing acidity of the soil. For this reason, nitrate of soda is a particularly safe source of nitrogen for use in most of our soils where carbonate of lime is deficient. Upon very compact, clayey soil, which tends to bake, nitrate of soda, if used consecutively without carbonate of lime, may so increase this tendency as to work great injury to the soil, as was well illustrated at Poppelsdorf, near Bonn on the Rhine, Germany, in experiments being conducted by Woltmann in the summer of 1898.

Aside from the influence of nitrate of soda and sulfate of ammonia upon the chemical reaction of the soils so far as concerns their alkalinity or acidity (which is a potent factor in the growth of many plants even in the case of upland soils), there is another point that must not be omitted. Reference is now made to the possible action of the soda as a direct or indirect manure. If the soda is of agricultural value in either or both of these ways, then we have a still stronger reason for using nitrate of soda as a source of nitrogen in preference to sulfate of ammonia, unless the cost of nitrogen in the latter substance drops materially below its price as nitrate.

Atterberg * conducted experiments in "quartz sand" in

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* Deut. landw. Presse 18 (1891), No. 102, p. 1035.

1891, and showed that where soda replaced potash in varying amounts the crops suffered far less than when the potash was replaced by lime. From this he concluded, quite contrary to the then prevalent opinion, that soda can act as a direct plant food, and replace potash to some extent. Pagnoul * also obtained results pointing in the same direction, and Wagner and Dorsch † a little later expressed their own conclusions as follows: "The soda is able to exert a decided influence upon the development of plants, and that cultivated plants are able to produce almost half as much more yield out of one and the same amount of potash when they are manured with sodium chlorid" (common salt). Stahl Schröder ‡ now comes forward with data and arguments which to his mind overthrow the conclusions and results just mentioned, and he states plainly that he believes he has proved "that soda cannot take the place of the potash which is necessary to the building up of the organic substance."

Experiments upon the soda question, embracing fifty-eight plots in the field and more than as many pots, have now been in progress at the Rhode Island station for several years, and, as a result of these, it may be definitely stated that, when the supply of readily assimilable potash is limited, soda is of some use, though whether as a direct or indirect manure cannot be determined until the analysis of the crops can be completed. The question whether plants can utilize soda as direct plant food savors perhaps too much of pure science to appeal to all practical farmers. Yet the question whether or not soda may be substituted for potash to some extent *in the manures applied to the land* will doubtless be considered practical by all. If the potash in our manures can be sufficiently reduced so as to make the soda which may be substituted for it effective, without lowering the yield or quality of the crop enough to more than offset the lesser price of the soda, it becomes important that it should be known. No benefit from soda appears, in the Rhode Island experiments, when a generous amount of potash is

* Annales Agronomique 17 (1891), pp. 538-544.

† Die Stickstoffdüngung, Berlin, 1892, pp. 227-242.

‡ Jour. für Landwirthschaft 47 (1899), pp. 49-84.

used, so that the only way to make it effective is to limit the potash, supplied in the manure, to such an extent that the plant does not find in the soil in assimilable form sufficient for its immediate needs. It is possible that this practice may be permissible upon certain soils and with certain kinds of plants, but not with others, the indications thus far obtained at Rhode Island pointing strongly in that direction. Until it is learned more definitely with what plants and upon what soils soda may be considered as capable of replacing potash in our manure, one is not safe in allowing the soda question to influence him materially in the choice between nitrate of soda and other sources of nitrogen. So much can be stated, however, viz., upon soils which are acid, nitrate of soda has for several years invariably given better results with beets, spinach, lettuce, asparagus and several other plants than the same quantity of nitrogen as sulfate of ammonia, even when lime was applied in each case at the same rate.*

Organic Nitrogen. — Under the general term organic nitrogen is classed the nitrogen of animal and vegetable substances. Among those most frequently met with in our markets may be mentioned dried blood, finely ground fish, tankage, bone, horn meal, hoof meal, cotton-seed meal, linseed meal and castor pomace. The agricultural value of the nitrogen in these different materials varies widely, dependent upon the chemical and physical character of the soil, the temperature, moisture and other factors which determine how rapidly decomposition is brought about, ammonia produced, and this in turn transformed into nitric acid.

P. Wagner and Dorsch † give the following as the relative degrees of assimilability of the nitrogen of a number of different organic substances, determined in a three-years successive trial, in pots, and with the same soil, whereby the cumulative as well as the immediate effect could be observed. The assimilability of nitrate nitrogen is placed at 100 for purposes of comparison.

* Compare the results secured in experiments upon the effect of lime upon the growth of plants. Reports Rhode Island Agricultural Experiment Station, 1893-1899 inclusive.

† Die Stickstoffdüngung, Berlin, p. 247.

Nitrogen in nitrates,	100
Nitrogen in sulfate of ammonia and raw Peruvian guano,	83
Nitrogen in dried blood, horn meal, castor pomace and green plants,	65
Nitrogen in horn meal, dried fish and meat,*	53
Nitrogen in wool dust and stable manure,	25
Nitrogen in leather meal,	15

These are only approximate figures; they are nevertheless of much value as indicators of the variation in the possible effectiveness of such manures. Experiments by Lindsey have shown that treatment of leather with sulfuric acid increases greatly its assimilability. This treatment tends to break up the structure of the leather, and, if continued long enough under favorable circumstances would change the nitrogen to sulfate of ammonia, when its efficiency would of course correspond with that material. Th. Pfeiffer has recently obtained much higher results for dried blood than those given by Wagner, and finds that it approaches more nearly sulfate of ammonia as a source of nitrogen. In fact, his results accord much more closely than Wagner's with those secured in Rhode Island in pots sunk in the ground, filled with natural soil and subjected to approximately normal conditions of temperature and moisture. In these Rhode Island experiments, letting 100 represent the assimilability of the nitrogen of nitrate of soda, the following data were obtained: —

	Upon Limed Soil.	Upon Unlimed Soil.
Nitrogen in nitrate of soda,	100	100
Nitrogen in sulfate of ammonia,	92	-†
Nitrogen in dried blood,	90	46
Nitrogen in ground steamed leather,	14	1

* Tankage contains on an average about 6 to 7 per cent of nitrogen, which is often present to a considerable extent as meat associated with tendons, etc., and with bone.

† Upon this soil it poisoned the plants.

That the soil conditions were favorable for nitrification upon the limed soil is evident from the high assimilability of the sulfate of ammonia and of the dried blood, but where no lime was applied the nitrogen of the dried blood proved only half as effective as it should have been. The nitrogen of steamed leather proved but about one-sixth as effective as the nitrogen of blood, even where the conditions for its transformation to nitric acid were excellent, and upon the acid soil it was almost utterly worthless.

Credible information is afforded by those familiar with the trade that many of the less assimilable forms of organic nitrogen are employed in the manufacture of commercial fertilizers, even including steamed or roasted leather. Under such circumstances only those who can have confidence in the manufacturer of their goods, and receive an assurance as to the nature of the nitrogen put into them, are in position to buy ready-mixed commercial fertilizers without the chance of being defrauded. In States where the quantities of nitrogen present in such goods in the form of nitrates and ammonium salts are determined, one can be thoroughly assured in regard to the agricultural value of at least a portion of the nitrogen. This is practised in New Jersey, Connecticut and Rhode Island, and there seems no good reason why Massachusetts should be behind her sister States in reaching out to the farmer a helping hand in this respect. If the fees paid to the State of Massachusetts are not sufficient to cover the cost of this additional work, many of the manufacturers would doubtless gladly assist in having the fee raised in order that the true merit of their goods might be shown by analysis. Attempts have been, and are now being made by chemists, to determine by chemical means the relative value of even the organic nitrogen in different brands of commercial fertilizers; and just as soon as a satisfactory method can be found, the character of this nitrogen should also be determined and reported. The importance of this matter is not measured by the value of the nitrogen purchased, but by the loss in the crop, due to inferior crop-producing power of the fertilizer, and may therefore amount to an enormous item annually even in the State of Massachusetts.

After what has been said in relation to the various forms of nitrogen, several points may be concisely stated: —

1. Nitrogen in nitrates* acts more quickly than in other substances, and is therefore particularly recommended where supplementary applications are desirable during the period of growth.

2. Nitrate nitrogen is particularly adapted to vegetable growing, greenhouse work or for the spring top-dressing of grass or grains; but, owing to its tendency to leach, it should rarely be applied in the autumn, and if at all only on very exhausted land, and in a quantity only sufficient to give the crops a start before winter.

If applied early and in large quantities to grain before it is well started, there is a tendency to excessive straw production at the expense of the grain.

3. Upon acid soil, where there may be some delay or difficulty in the transformation of other forms of nitrogen into nitric acid, nitrates are particularly applicable, and will give most favorable results with spinach, lettuce, beets, asparagus, Kohl rabi, cauliflower, cabbage, tomatoes and many other garden crops.

4. On very light soils, or where the crop grows for a long period, nitrates will generally prove more efficacious if applied in two or three successive portions than when applied at once.

5. Owing to the danger of its being destroyed by denitrification and the loss of the nitrogen as gas, but little nitrate of soda should be applied at a time, either in the greenhouses or in fields, in case excessive amounts of only partially rotted manure have been employed.

6. Sulfate of ammonia is less liable to loss by leaching than nitrate of soda, and it is not quite so rapid in its action.

7. Upon grass and cereals where, and at times when, the conditions are favorable for its being carried into the soil and quickly changed into nitrates, sulfate of ammonia is apt to prove nearly as effective as nitrates.

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* Nitrate of potash, though an excellent source of nitrogen, is seldom used in agricultural operations, for the reason that nitrogen and potash can usually be bought in other materials for less money.

8. Upon acid or light sandy and gravelly soils, sulfate of ammonia is liable not only to give inferior results, but to act as a poison unless slacked lime or wood ashes is first applied to the soil.

9. Dried blood is generally considered to be the most effective form of organic nitrogen obtainable. In its purchase, however, the high grade, containing from 12 to 13 per cent of nitrogen, is less likely to be found adulterated than the lower grades. The assimilability of the nitrogen of blood is eventually, under the most favorable soil conditions, not far behind that of sulfate of ammonia, though, owing to the necessity of its first being changed to ammonia, it does not usually act so quickly.

10. The nitrogen of cotton-seed meal, linseed meal, castor pomace, fish, tankage and horn meal is not so quick in its action as that of blood, for which reason it is not so well adapted to greenhouse work. For tobacco, or whatever crops enjoy a long period of growth and in seeding land to grass, these materials are particularly applicable, provided they can be had at a reasonable price. Unless the price is very low, top-dressing with nitrate of soda just as the grass is starting will prove much more economical.

11. Organic nitrogen is particularly applicable upon very light soils, where loss of nitrogen by leaching is to be feared, for the reason that it is continually becoming assimilable, and is always present to some extent to meet the demands of plants.

12. A given amount of organic nitrogen, if quite readily assimilable, as, for example, in blood, may, under certain circumstances, produce a greater yield than the same amount of nitrogen in the form of ammonium salts or nitrates, provided the latter materials are all applied in large quantities at once, when the plants are very young or before growth has commenced. The reason for this is that excessive amounts of those salts may act injuriously upon young and tender plants. When applied properly and in limited amounts, a given amount of nitrogen as nitrate of soda or as sulfate of ammonia may, as already stated, be expected to give a considerably greater yield than as organic matter.

Stable Manure, its Treatment and Application.

Probably during no period of the century has so much attention been paid to the investigation of stable manure with special reference to the conservation of its nitrogen as during the past two or three years. This has been largely due to a prize offered by the German Agricultural Society for the best investigation in this line. Owing to some of the striking conclusions arrived at by certain German investigators, Dehérain in France and a large number of bacteriologists in various countries have also lent their aid to the solution of this problem. The limits of several papers would be required to give the successive steps and details of these investigations, so that only the briefest reference can be made here to some of the main features and to the practical outcome of the investigations.

The losses of nitrogen from stable manure are essentially due to two causes: —

1. To the formation of ammonium carbonate in the process of decomposition, and, finally, the escape of this ammonia into the air in gaseous form.

2. To a reduction of the nitrates and nitrites formed as a result of the more or less complete nitrification of the ammonia, by which nitrogen is evolved into the atmosphere in a gaseous state.

Early in the investigation of this question evidence was brought forward indicating that the chief loss actually occurs in the form of nitrogen gas as a result of the so-called process of denitrification. Subsequent discussion and observation indicate however, that the losses as ammonia are more serious. The losses in the first category were especially studied by Professor Wagner and others, who found that when manure was applied to the soil but little effect was produced by the nitrogen, and, furthermore, it was found that it even caused the denitrification and loss of the nitrogen applied in connection with it as nitrates. It was quite generally supposed at that time that this was due to the presence of unusual numbers of the denitrifying organisms in the manure. Straw was subsequently found to cause the same destruction, and was also looked upon as a bearer of these

organisms. Subsequent investigations by Dehérain and others have shown that the facts noticed were to be explained upon the ground that the straw and manure contained suitable food for the organisms, for instance, starch, sugar, xylan, araban, etc., and not to any practical extent on account of organisms which they themselves carried to the soil. Dehérain, with his characteristic insight and grasp of experimental inquiries, soon showed that in the German experiments excessive amounts of manure were mixed with the soil, and that where such moderate quantities are applied as is usually customary, outside of special gardening operations, such serious losses would not occur as had been claimed by the Germans, who had worked under abnormal conditions. He has further shown that manure spread upon the fields or distributed in small heaps suffers a rapid loss of ammonia. The first step is shown by him to be an escape of carbon dioxid (carbonic acid gas), which renders possible the escape of the ammonia, such losses not occurring so long as an excess of this compound is present. Less loss would result, then, when manure is firmly compacted than when it is easily permeable by the air. Serious losses of ammonia from liquid manure, when it is kept separate from the solid portions, do not so readily occur. Dehérain states that the ideal way to apply the manure is to take it to the field and to spread it at once, then follow with a plough, turning a shallow layer of soil over the manure at once. Little or no loss of ammonia will occur through a thin layer of soil. It seems probable that Dehérain has struck the key-note of the problem, though there is much in the way of carrying out, practically, his last suggestion. If one could always have a rain descend upon the manure as soon as it is spread, provided the surface of the ground is in a state to absorb the liquid, the losses of which he speaks would be reduced to a minimum, even if the manure were left on the surface, since the liquid portion held by the solid would be largely washed into the soil, where, as is well known, it is practically safe. The nitrogen of the solid portion cannot so quickly and readily escape.

These various investigations have shown that one reason for the superiority of rotted over fresh manure lies in the

fact that in the process of decomposition much of the bacterial food is destroyed, and in consequence the subsequent tendency to decompose nitrates is reduced. In recent greenhouse experiments at the Rhode Island station, where stable manure only partially rotted was applied at the rate of seventy-five tons per acre, it ceased to support the growth of plants after the removal of two crops of radishes and one of lettuce, and experiments revealed the fact that it was due to the absence of nitrates. Where chopped hay was mixed with the soil, nitrate nitrogen practically disappeared in a comparatively short time, which was not the case where organic matter was not applied. It is recorded that Lawes and Gilbert found a marked lack of durability in the nitrogen of stable manure when large quantities were applied to the land annually for several years, which is unquestionably explainable upon the same ground.

The more perfectly herbivorous animals digest their food, the less is the tendency of the manure to cause the reduction of nitrates. The ground for this is that, with the more thorough digestion, less food suitable for the growth of the denitrifying organisms remains in the fæces. This may explain why, for certain purposes, sheep manure is preferred by many in greenhouse work (where much manure is incorporated into a small body of soil) to cow manure, and particularly to horse manure.

Magnesia.

Magnesia, though essential to plant growth, is not usually looked upon as sufficiently lacking in soils to render its application to them necessary. In all probability, sulfate and perhaps other salts of magnesia may act like gypsum (land plaster) in setting free potash and other manurial substances for the use of plants. It is possible, also, that magnesia may be lacking in certain soils to a greater extent than is usually supposed. Larbalétrier and Malpeaux * report several trials in which marked benefit from its use in France was observed; and recent unpublished experiments, conducted at the Rhode Island station in natural soil liberally supplied with the customary manurial substances have given

* Annales Agronomique 22 (1896), pp. 20–32.

evidence of marked benefit from the presence of magnesium, even when applied as a chlorid, which by many writers is said, without qualification, to act as a plant poison. If further investigations indicate a more general need of magnesia than has been supposed, it can be bought at a low price as ground Kieserite and as a constituent of Kainit and of double sulfate of potash and magnesia. Magnesian lime * could also be employed, particularly wherever soils stand in need of carbonate of lime. Where considerable magnesia is present and lime is lacking it has been shown by Loew to act very poisonously upon plants; it is therefore important to see that the soil is sufficiently supplied with lime wherever magnesia is to be employed. Wood ashes usually contain from about three to four per cent of magnesia, associated with about thirty-five per cent of lime, thus making them a splendid source of magnesia. It is not improbable that this ingredient is often responsible in some degree for the beneficial effect which such ashes exert.

Lime.

Lime, like magnesia, is essential to plant growth, though it has been generally considered in the United States as being present in soils to a sufficient extent to supply the demands. As notable exceptions to this, it may be mentioned that it has long been applied to certain soils in New York and Pennsylvania with marked benefit. Early in the present century it was employed in Virginia by Ruffin and others with great success. Its use upon the acid soils of Limmousin and other portions of France has utterly revolutionized their agriculture, and made prosperous, regions where formerly only a miserable existence was possible. It is to-day the key to successful agriculture in certain sections of Germany, and upon some of the moorlands (peat and muck soils) successful agriculture is impossible without it, — a fact most vividly brought out by the experiments in progress by the Moor Experiment Station of Bremen. Probably no single ingredient of soils fulfils so many functions and exerts so marked an influence upon the character of soils and the growth of plants as lime.

* Burned lime, containing much magnesia.

1. It serves as a direct plant food.

2. It is a potent factor in binding sand and in rendering clay soils more friable.

3. It promotes the decay of organic matter and the formation of humus.

4. It increases the nitrogen content of humus, by which its efficiency as a source of nitrogen is increased.

5. It is indirectly an active agent in promoting the change of ammonia and inert forms of nitrogen into immediately assimilable forms.

6. It hinders denitrification, or the loss of nitrogen in the gaseous form.

7. It is an important agent, when applied to soils, in combating the club foot of the cabbage, turnip, etc.

8. Upon quite acid soils, while not increasing greatly the total yield of potatoes, it has a marked favorable influence upon the percentage of large potatoes produced.

9. It overcomes the acidity of upland and other soils, which, though resulting injuriously to cranberries, blackberries, lupine, azaleas and perhaps a few other agricultural and ornamental plants, and favoring potato scab, nevertheless aids in the extermination of common sorrel, and favors in a wonderful manner the growth of most agricultural plants, among which may be mentioned, by way of illustration, wheat, barley, onions, beets, spinach, lettuce and asparagus.

10. It sets free potash, within the soil, and where phosphoric acid exists in large quantities, in certain forms which are but slightly assimilable, its application may liberate sufficient phosphoric acid to wholly supply the needs of plants for several years.

11. These are not all of the beneficial influences that might be briefly summarized; but, to abbreviate, further allusion will only be made to a recent observation, an account of which has just been published in Belgium, to the effect that in malarial regions the fever disappears after the land is limed. Should this be established, it would but verify the claims brought forward by Ruffin, in Virginia, early in this century, and prove a boon in this way not only to the farmers but to others as well.

This subject of lime is too important to be passed over without further general comment. Upland and naturally well-drained soils have not been usually considered, in this country, as sufficiently acid to prove injurious to plants; and the occurrence of such a degree of acidity in such soils in New England has been, if not publicly, yet privately and by way of personal correspondence, questioned by several of the leading agricultural chemists and professors of agriculture in New England. Notwithstanding this, carbonate of lime has been shown to be so deficient in many sections of Rhode Island that the *profitable* production of beets, clover, timothy and many other crops is impossible until the acidity of the soil has been reduced by the use of alkaline applications, such as stable manure, wood ashes and lime. Even upon precipitous hillsides, with a fall of one foot in every six to ten feet descent, similar observations have been made. As a result of this, farmers in other States have taken to testing their soils and using lime, records of wonderful successes from its employment having come to hand from New Jersey, sections of New York, where it was not supposed to be lacking, Connecticut, New Hampshire, and also from Wellesley, Westminster and Bolton in the State of Massachusetts.

These statements are made with the full knowledge of the fact that the professor of agriculture at your Agricultural College conducted many experiments with lime in Massachusetts, and found it of little or no use. The applications made were, however, too small to show marked results, and the experiments were conducted with Indian corn, a plant which thrives well on acid soil, and which seldom shows, superficially, a marked benefit from liming, provided it is supplied with a liberal amount of the three usual elements with the nitrogen as nitrates.

Personal observations and chemical tests of soils lead to the belief that many sections of Massachusetts may be greatly benefited by a further study of this question, if conducted in the proper way; and to the further conviction that, though still apparently almost ignored so far as concerns the State at large, it is a most promising field for investigation by your experiment station.

Air slacked or water-slacked lime may be applied to soils at a rate of from one half to two and one-half tons per acre. Upon light, sandy or gravelly soils small applications should be made, while heavier clayey soils, particularly if rich in humus, may be dressed at a greater rate.

Lime should be spread upon the surface of the ground, and thoroughly harrowed in, preferably shortly before seeding or before some crop especially helped by it. Full details regarding lime and its use may be obtained by sending to the United States Department of Agriculture for Farmer's Bulletin No. 77, on "Lime and its use."

It is possible for the practical farmer to obtain a good idea as to whether his land stands in need of lime. If clover fails to thrive, if beet leaves turn red and many of the plants die or remain small, if onions cannot be successfully grown, if timothy runs out too quickly and if the soil is infested with sorrel, there is good reason to suspect a lack of lime. To determine more definitely, the following suggestions will be of service: —

Soils which contain any considerable amount of carbonate of lime are either neutral in their action upon litmus paper, or, as is usually the case, they are alkaline. A neutral soil does not change the color of either a blue or red litmus paper. An acid soil will turn a blue paper red and an alkaline soil will turn a red litmus paper blue. To learn if a soil is acid (sour), take a tablespoonful or more of soil and place it in a glass or cup, moisten with sufficient water to make it about like a very thick paste. If possible, allow it to stand fifteen minutes to an hour, though in very acid soils the test will readily show at once. With a knife blade part the soil and introduce one end of a piece of blue litmus paper, one-fourth to one-half an inch wide and two inches long, taking care not to touch the fingers to the end introduced. Press the soil against the paper. After from five to fifteen minutes, remove the paper, rinse the soil from it as hastily as possible, taking care not to wash the blue color from above into the portion of the paper that was in the soil, and if it has turned distinctly red, there is evidence that lime is needed. If the soil has a strong reddish tint, as is sometimes the case, and tends to cling to the paper, bring

the soil only in contact with one side of the paper, and observe if the blue color of the exposed side changes to red, if so, the soil is acid.

In case a soil contains any considerable excess of carbonate of lime or magnesia, the humus will be mostly held in combination, insoluble in ammonia water; while on many soils, if ammonia water dissolves large quantities of humus, there is a probable lack of lime. This test, which cannot take the place of the litmus paper test, but which may well supplement it, is made as follows: Take two glasses, add to each about two level teaspoonfuls of soil, fill the glasses about half full of water, and add to one a teaspoonful of ammonia water. Stir each thoroughly, using in each a different stirrer. If, after two or three hours, the liquid in the one without the ammonia water is practically clear and colorless, and that in the other is quite dark brown or black, it may be concluded, provided the same soil reddened blue litmus paper, that it needs lime.

Before purchasing large quantities of lime it is well to make a small test in a practical way. Lay out two plots of land, twelve by fifteen feet, separated from each other by a space six feet wide. Apply a like weighed amount of any complete commercial fertilizer to each plot. Apply to one plot from ten to twenty pounds of lime, according to the lightness or heaviness of the soil. Work it in most thoroughly with a cultivator or rake. Plant a like weight of red table or mangel-wurzel beet seed on each plot. Note the growth and weigh the crop from each plot. If lime proves serviceable, use it judiciously for other crops liable to be helped by it.

Chlorine, Soda, Sulfur, Iron, etc.

The question of soda has been discussed in connection with nitrate of soda. Chlorine, like soda, has been much in dispute as to its being essential to plant growth, but it seems probable that it performs useful functions. Pfeiffer has recently recorded an appreciable benefit from its use upon potatoes. It is, however, a constituent of muriate of potash and to some extent of most fertilizers, so that its special application is supposed to be practically unnecessary.

Iron, though usually ignored as a necessary application for soils, is nevertheless as essential to plant growth as any other ingredient. Fortunately, soils are practically always sufficiently supplied with it. It has been applied, however, in many cases as proto-sulfate of iron (green vitriol) with most marked advantage. However, its usefulness in such cases has been usually by virtue of its liberating potash and possibly other plant food, and sometimes owing to its proving a remedy for certain diseases affecting the roots of plants.

Sulfur is also an essential element in the growth of plants, though usually soils receive enough of it in the various manures; many of the German potash salts, as well as superphosphates, containing large quantities of it in the form of sulfate.

After what has been said in relation to the special action of different forms of plant food and the influence of the character of the soil upon their assimilability and relative adaptabilities, it must be evident that no general rules for manuring, applicable to all crops, can be laid down for a given soil, nor can specific rules be laid down for a given plant applicable upon soils of all classes. It must be equally manifest that the purchase and use of complete commercial fertilizers without a knowledge of their chlorine content and of the nature of the nitrogenous materials which they contain can be classed as neither scientific nor practical; and yet this is what farmers are forced to do who employ such goods, so long as the analytical data are not sufficient to tell them what they are actually buying. That the statements of certain manufacturers are and will continue to be misleading there can be no question, unless the consumers ask for what protection they should have. As previously explained, chemistry has not as yet been able to tell with satisfactory exactness the relative values of the organic nitrogen, though most hopeful progress has already been made. While waiting for the further perfection of methods to be used in the protection of the interests of the farmer, there should be no neglect of the opportunity to ascertain for him everything that can be determined in relation to the character of the commercial manures. With trusts and combinations to control the price

of everything he buys and most that he sells, and with petty jealousies and a thousand difficulties in the way of organizing and working for common interests, there never was a time in the history of this country when it was more imperative that our agricultural interests should have all the protection from fraud which law can afford.

Soil Tests by Means of Plants and Fertilizers.

Soil tests by means of chemical manures and plants have been widely advocated for ascertaining the deficiencies of special soils, in order that farmers may not continue to use large amounts of certain fertilizer ingredients unnecessarily, these tests having proved more satisfactory as a means of ascertaining their needs than resort to chemical analysis alone.

In such tests, the use of potash, phosphoric acid and nitrogen in suitable combinations has usually been considered sufficient to determine the relative lack of any one of these three soil ingredients. Recent experience at the Rhode Island Experiment Station prompts the belief that even tests conducted in this way may occasionally lead one to draw totally false conclusions as to what applications may prove most economical for a given soil, and that satisfactory conclusions cannot be drawn as to the relative deficiencies of these three ingredients until the soil is first put in proper condition by the application of everything else which it may need for correcting any unsatisfactory chemical or physical condition which may exist. Even at their best, certain of these tests may answer the question for this field and not for that; they may give one indication the first year and a different one later. They may, however, prove highly useful in showing great deficiencies which were not suspected, and, if continued long enough upon the same location, they may indicate about how much of certain soil ingredients is liable to be liberated annually for the support of plants, so that the artificial application may be based thereon.

System in its Relation to Manuring.

What seems to be needed is more system in our agriculture, the employment of more definite rotations, and then systematic and long-continued study on the part of our

experiment stations of soils most truly representative of different sections, to ascertain, taking into account losses by drainage and the ingredients removed by crops, what quantities of the various manurial ingredients must be applied annually or at other intervals to most economically maintain maximum crops and normal soil conditions. Such work on the part of the stations requires, as previously stated, continuity of effort, and involves some reasonable assurance of tenure of office; for otherwise we shall continue to have the lamentable picture of station workers undertaking only experiments which they can reasonably hope to complete in a short time, — a policy to which there are now too few exceptions, particularly in those States where the advancement of science and the promotion of public interests are subserved to seeking party spoils.

He who has been an observing student of the fertilizer problem from the birth of the Stockbridge formulas until the present day cannot deny that the fertilizer manufacturer has rendered an important service to agriculture in calling attention to the beneficial action of chemical manures, since, had he not sent his commercial missionary, the travelling salesman, to practically every farmer in the land, the knowledge and use of fertilizers would probably have become far less general. Admitting that many farmers through laziness and lack of business enterprise have bought fertilizers recklessly, yet much good seed has been sown.

The question that comes home to the Massachusetts farmer to-day is this: Is it the best economy to employ ready-mixed fertilizers without more definite knowledge of the materials employed in compounding them, particularly in view of the difference in the specific action of the various ingredients upon special soils and crops? In Germany, thanks to the use of the facilities for agricultural education, the progressive agriculturist does not doctor his land by the employment of universal panaceas containing a mixture of all of the medicines given in the agricultural pharmacopœia, but employs the materials and doses to suit the individual requirements of the particular case in hand. To be sure, mixtures of superphosphate and sulfate of ammonia, as well as nitrate of soda with superphosphate in definitely stated

proportions are sold in large quantities; but these are supplemented judiciously by the use of potash salts, basic slag, bone meal or other materials, according to the special requirements. Occasionally also so-called complete manures are sold even in Germany, in certain instances a large proportion of sand and nitrogen in the form of steamed and roasted leather being mixed with mineral phosphate, in order to meet the demand of the ignorant peasant who thinks of the *amount* of the ingredients or weight of materials obtained regardless of the assimilability, and who pays freight on sand under the delusive influence of the too common idea that that which is offered at a low price is necessarily most economical. If such a system of purchasing fertilizers is to prevail to so great an extent in this country as at present, if the brand name and the cost or commercial value of the goods is to be the crucial criterion used in buying, and if greater attention and study are not given to this subject, the future of agriculture must remain more or less dark, and the time spent by our stations in solving the important problems bearing upon plant production will have been spent in vain. There is not to-day one young man in your Agricultural College where there should be fifty, and many farmers are still plodding. The future of the American farmer will be determined by whether he goes into farming with ready capital, or with an overwhelming mortgage, bearing from thirty to fifty per cent greater interest than the capital invested in other occupations; by his business enterprise; and by his education and consequent ability to meet and cope with other business combinations. Shall the American farmer become a peasant, or a business man? For the benefit of the masses, and to the end that the oldest and most honorable occupation of mankind may be ennobled instead of degraded, and that the work of agricultural investigation may go forward and its teachings be economically applied, let your Agricultural College, as such, be strengthened in certain departments; carry, then, repeatedly, by special emissaries if necessary, a knowledge of what it offers to every farm in the Commonwealth and the future of your agriculture and of the Massachusetts farmer will be assured.

Appendix.

Factors for Use in comparing Guaranties.

Frequently, in securing quotations on agricultural chemicals and fertilizer stock, one party will guarantee ammonia and another nitrogen, some guarantee bone phosphate and others phosphoric acid, and again one may guarantee either sulfate or muriate of potash, while others state the amount of actual potash. In order to compare prices quoted in this manner, the following will be found useful: —

Multiplying the per cent of ammonia by .82 gives the nitrogen.

Multiplying the per cent of nitrogen by 1.21 gives the ammonia.

Multiplying the per cent of pure* muriate of potash by .63 gives the actual potash.

Multiplying the per cent of actual potash by 1.58 gives the pure muriate of potash.

Multiplying the per cent of pure* sulfate of potash by .54 gives the actual potash.

Multiplying the per cent of actual potash by 1.85 gives the pure sulfate of potash.

Multiplying the per cent of bone phosphate by .46 gives the phosphoric acid.

Multiplying the per cent of phosphoric acid by 2.18 gives the bone phosphate.

The kinds of chemicals or fertilizer stock that should be used depend upon the character of the soil, the relative cost of the materials and the particular crop to be grown. To assist those who may wish to substitute one kind of material for another without materially affecting the amount of the particular manurial ingredient employed, it is hoped that the following will be found serviceable. Any of the following substitutions may be made without materially changing the amounts of nitrogen, available phosphoric acid and potash: —

For 100 pounds of nitrate of soda, either 76 pounds of sulfate of ammonia, 141 pounds of dried blood or 235 pounds of cotton-seed meal.

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* Ordinary muriate of potash as commonly sold contains but about 80 pounds of muriate of potash per hundred, the balance consisting chiefly of common salt; while ordinary high-grade sulfate contains about 90 pounds of sulfate of potash per hundred.

For 100 pounds of sulfate of ammonia, either 132 pounds of nitrate of soda, 186 pounds of dried blood or 311 pounds of cotton-seed meal.

For 100 pounds of dried blood, either 71 pounds of nitrate of soda, 54 pounds of sulfate of ammonia or 167 pounds of cotton-seed meal.

For 100 pounds of cotton-seed meal, either 43 pounds of nitrate of soda, 32 pounds of sulfate of ammonia or 60 pounds of dried blood.

For 100 pounds of dissolved phosphate rock, either 76 pounds of dissolved bone-black or 33 pounds of double superphosphate.

For 100 pounds of dissolved bone-black, either 131 pounds of dissolved phosphate rock or 43 pounds of double superphosphate.

For 100 pounds of double superphosphate, either 308 pounds of dissolved phosphate rock or 235 pounds of dissolved bone-black.

For 100 pounds of tankage, either 39 pounds of nitrate of soda and 38 pounds of dissolved phosphate rock, 29 pounds of sulfate of ammonia and 38 pounds of dissolved phosphate rock, 55 pounds of dried blood and 38 pounds of dissolved phosphate rock, 91 pounds of cotton-seed meal and 38 pounds of dissolved phosphate rock, 80 pounds of dry ground fish and 14 pounds of dissolved phosphate rock, or 45 pounds of fine-ground bone and 33 pounds of nitrate of soda.

For 100 pounds of dry ground fish, either 48 pounds of nitrate of soda and 31 pounds of dissolved phosphate rock, 37 pounds of sulfate of ammonia and 31 pounds of dissolved phosphate rock, 68 pounds of dried blood and 31 pounds of dissolved phosphate rock, 113 pounds of cotton-seed meal and 31 pounds of dissolved phosphate rock, 80 pounds of tankage and 17 pounds of nitrate of soda, or 36 pounds of fine-ground bone and 44 pounds of nitrate of soda.

For 100 pounds of fine-ground bone, either 13 pounds of nitrate of soda and 85 pounds of dissolved phosphate rock, 10 pounds of sulfate of ammonia and 85 pounds of dissolved phosphate rock, 18 pounds of dried blood and 85 pounds of dissolved phosphate rock, 30 pounds of dissolved cotton-seed meal and 85 pounds of dissolved phosphate rock, 33 pounds of tankage and 72 pounds of dissolved phosphate rock, or 27 pounds of dry ground fish and 76 pounds of dissolved phosphate rock.

For practical purposes, muriate and high-grade (48 to 50 per cent) sulfate of potash may be substituted, each for the other, in equal quantities; in replacing either of these by low-grade sulfate (double sulfate of potash and magnesia), double the quantity should be used; or in replacing either by kainit, four times the amount should be used.

In the above calculations the basis of composition used was, for dried blood, 11 per cent of nitrogen; for tankage, 6 per cent of nitrogen and 5 per cent of available phosphoric acid; for fish, 7.5 per cent of nitrogen and 4 per cent of available phosphoric acid; and for fine-ground bone, 2 per cent of nitrogen and 11 per cent of available phosphoric acid.

As a general rule, if dissolved phosphate rock containing between 12 and 13 per cent of soluble phosphoric acid can be bought at $15 per ton, that is about the same from the farmer's stand-point as dissolved bone-black at $19.50 per ton; *or, for a rule that will fit all cases, multiply the price of dissolved phosphate rock by 1.3, and, if the result is above the price at which dissolved bone-black is offered, then buy the latter; if the result falls below the quotation for dissolved bone-black, then take the former. If double superphosphate can be bought at three times, or less than three times, the cost of dissolved phosphate rock, then it is usually more economical than the latter.*

Prof. W. P. Brooks (of Amherst). In rising to speak, I wish in the first place to express my most hearty appreciation of the very able paper to which we have listened. It was full of good things, so full that I fear very few of us will be able to carry them all away with us I want to say that in my opinion this paper is one which, to a very unusual degree, will repay careful reading and careful study. It will become available to all of you, and I sincerely hope that you will not conclude that, having heard it, you do not need to pay further attention to it. You will find by reading it with care that there are many hints that will pay you many times over to act upon.

There are just a few of the points referred to by the essayist to which I wish to refer. You will remember, in the first place, the paper discussed the question of potash, the sources of potash, — wood ashes, cotton-seed hull ashes, nitrate of potash, carbonate of potash and magnesia, were all spoken of. Wood ashes, as you are well aware, are used in the Connecticut valley, where tobacco is grown, more largely, probably, than in almost any other part of our country, and I am convinced, as a result of observation, that they con-

stitute a splendid manure at the price at which they are generally sold. We have one field of about six or seven acres on the college farm which illustrates this pretty well. This field has been kept in grass for about twelve years. It is divided into three nearly equal parts, and for some time has been manured in this way: one year one of the three parts into which it is divided receives a small, rather moderate dressing of manure, — about four cords; the second part receives an application of wood ashes, — a ton to the acre; the third receives an application of muriate of potash, — about two hundred pounds, and bone meal, — about four hundred pounds. The next year the manuring is rotated; the part that this year got the barn-yard manure, next year gets wood ashes; the part that this year got the wood ashes, next year gets the bone and potash; and so on from year to year. The results upon this field go very far to show that such a system of manuring is an excellent one. We have obtained for the last ten years an average of rather more than three and a half tons to the acre of good hay in two crops, by this system of manuring. So much for wood ashes. Of course the benefits in this case are not to be ascribed wholly to the wood ashes, but I believe that rotation of manuring is an excellent thing. I am not at all sure but that still better results might be obtained by using a little nitrate of soda in connection with the ashes in the spring, put on separately; and possibly also in connection with the bone and potash.

The essayist discussed the relative merits of muriate of potash and sulfate of potash, and with his conclusions I entirely agree on most points. We have, however, at Amherst with a single exception always found that sulfate of potash not only gave potatoes of better quality but also more bushels than the muriate. We have fields upon the college farm where for about sixteen years we have had these two forms of potash under comparison. The system of manuring has been this: on one part, muriate of potash at the rate of four hundred pounds to the acre; the next, sulfate of potash, the same quantity; the next, the muriate; the fourth, the sulfate. There are eleven plots in all, alternating in this regular way. In connection with these potash salts we have

used every year bone meal in the same amount on all plots. We have been testing the relative value of these two forms of potash, and are now able to give you some hints which I believe you will find of great value. We find for many crops there does not appear to be any material difference in the value of the two salts. This is true of corn, and under this manuring, — four hundred pounds of one or the other and six hundred pounds of bone meal — we this year got one of the largest crops of corn for the silo that we have ever raised, — it amounted to something over thirty tons to the acre. It was a large variety of corn and the growth was enormous, and we got something over thirty tons to the acre where the land has for this long period (since 1884) been every year manured in this way, — one with muriate, the other with sulfate, and both with six hundred pounds of bone meal. The crop of corn this year was a little larger on the muriate of potash than on the sulfate. But in all our experience we have not found much difference in the value of these two salts for this crop. The same is true for grass. For cabbage there is a decided difference in favor of the sulfate; for beans, in favor of the sulfate; for sugar beets, in favor of the sulfate.

But I will not go further in the details concerning that point. That is not the most important fact I wanted to bring to your attention in connection with the use of these two salts. The fact is this: We have found that where we continue to use muriate of potash year after year the soil gradually gets into an unproductive condition. This condition appears to be connected with the loss of lime. Chloride or any kind of muriate of potash is the one we usually employ, unless we use kainit. The continued use of the chloride seems to result in the washing out of a considerable share of the lime in the soil.

We have found that, where we have used muriate of potash in moderate amounts — not exceeding two hundred pounds to the acre — for a series of years, the only way to bring the soil back was to give it a dressing of lime; and in my most recent publication on this subject of manuring I have called attention to this fact, and have there pointed out the fact that the apparent saving which you make by employ-

ing muriate instead of sulfate may be simply apparent and not actual; because, if you depend on muriate, you will find that it will be necessary to buy lime to make up for that which washes out of the soil as a result of the use of the muriate. The sulfate does not have this effect to anywhere near the same extent. It seems to be possible to use this year after year, for a long series of years; I cannot say how long. It seems to be possible to continue to use this for a long series of years without its being necessary to lime the land.

In connection with the series of plots I have just spoken of, where muriate and sulfate were used alternately for a long series of years, we had clover a few years ago. Clover occupied six different plots. We had three different kinds of clover, two plots of each kind; on one plot of each kind we used muriate and on the other sulfate. The difference in the clover was remarkable. The clover was sown in the latter part of July, in the summer of 1897. You will remember that this was a very wet summer. The clover came up well and grew apparently equally well on all plots during the late summer and fall. But in the spring there was a most astonishing difference in the condition of the clover on the muriate and on the sulfate. On the sulfate the plants were all alive and vigorous and the crop was magnificent, but on the muriate a large share of the plants were dead. This was true with all three kinds of clover. It was so many times repeated that we could not doubt that it was some peculiar influence of the muriate of potash that produced this result. We have since shown by another field that that influence appeared to be that to which I have called attention. The lime had been washed out of the soil, as a result of the continued use of the muriate. By liming the land we brought it into condition to raise clover again. If you have not had good results from the continued use of muriate of potash, it probably is because your land needs more lime.

Many of you buy mixed fertilizers. You should inquire, when you purchase, what is the source of potash. If the manufacturer or seller says nothing about it, you may conclude it is muriate, because he will naturally take the cheapest form.

The paper had something to say in regard to the availability of phosphoric acid in bone meal, as compared with basic slag and other materials. You will remember that I said each plot in this series received bone meal at the rate of six hundred pounds to the acre continually since 1884. That is a long time, and in all that time this field has not had one particle of manure of any other kind than bone meal and the two potash salts. I claim that on that soil the results show that bone meal is apparently a useful form of phosphoric acid as well as of nitrogen. I told you what the crop of corn was this year; over thirty tons to the acre of corn for the silo. Other crops this year and in recent years have been entirely satisfactory. We got on these plots yields of clover hay at the rate of three tons and more to the acre; yields of potatoes at the rate of two hundred and fifty to three hundred bushels per acre; we got satisfactory yields of beets, and, indeed, of all the common farm crops, — and that while we have depended wholly for this long series of years upon bone meal as the source of phosphoric acid and as a source of nitrogen.

In general, however, I would agree entirely with the position of the paper concerning the relative availability of the different materials which the farmer can purchase for supplying phosphoric acid.

One other phase of the subject: the materials which furnish nitrogen. Our experiments at Amherst have continually been carried out on such systems as to render the hints very suggestive and valuable. We have one set of plots where we have for a long series of years, about sixteen years, been using barn-yard manure on one plot as a source of nitrogen, sulfate of ammonia on several plots, nitrate of soda on others, dry blood on others, and we have in our results in general entirely confirmed the position of the speaker of the morning. We find the nitrate of soda the best for all crops. We generally find the dry blood next, rather than the sulfate of ammonia. We find if we use lime in connection with sulfate of ammonia it acts better; but used in connection with lime it hardly equals the dry blood on our soil, as a rule.

Doctor Wheeler. Are you sure the dry blood did not contain large quantities of phosphoric acid?

Professor Brooks. I suppose all dry blood contains some phosphoric acid, but I think this has been allowed for in determining the amount to be used.

I want to emphasize one other point; the possibility of making use of atmospheric nitrogen by the growth of clover. There are in this series of a dozen or so of plots three plots which for sixteen years have never received an ounce of nitrogen in any form. It is a long time to go without this which generally is so important in determining the amount of the crop. The crop on that land this year was clover, — common red clover, sown in July. A year ago this past summer we cut two good crops on these plots which now for sixteen years have not had an ounce of nitrogen supplied to them in any way, shape or form.

On these plots this year we got a clover crop practically the same as on those plots that have every year been manured heavily with barn-yard manure, or sulfate of ammonia, or dry blood, or nitrate of soda. On all the plots we have every year supplied potash and phosphate. They were comparisons of the sources of nitrogen. On the plots where we used no nitrogen we have this year got as good a crop of clover as on those where we used nitrogen every year. It is a fact of tremendous importance. You do not make as much use of these recent discoveries of modern science as you should. You ought to grow more clover, and you ought to make it work for a living. If you put it on land where there is plenty of nitrogen in the soil, it will not work for a living. It will not take two steps to get what it can get by taking one. If it can find nitrogen by taking one step, it will use it and not take the second step; but if it takes the first step and does not find it, then it is capable of taking another great long step into the air and getting the nitrogen there. You ought to act upon that discovery of modern science more than you do.

Question. Would you buy no nitrogen whatever?

Professor Brooks. Not absolutely that. There are conditions where the farmer cannot afford to depend on this method of getting nitrogen. The gardener cannot always afford to depend on it. I am not an unconditional advocate

of green crops. I do not plough in a crop that has a food value. I have grown clover to a great advantage over what it is commonly grown.

Mr. SESSIONS. Your experience has proved that the potash helps out the clover?

Professor BROOKS. Always. We have been putting potash on four out of fifteen plots. On different plots we have various combinations of fertilizers and ingredients, — lime, phosphate, nitrate of soda, barn-yard manure, etc. We have kept it up year after year, similar manures on similar plots, then planted with clover and sowed back and forth and across the field, so that we would have the same amount of seed on all plots. Where we put the potash there is the clover every time; where there is no potash there will be no clover. Potash is not the only thing essential. You must make sure that every one of the constituents of plant food is present in abundance.

Something was said by the speaker this morning concerning the relative value of different materials. I want to add one other point. Generalizations, I admit, are dangerous; conditions alter cases, alter results; but this generalization I believe is safe. For all those crops that must make most of their growth in the early part of the season you will probably without exception find that nitrate of soda is altogether the best source of nitrogen that you can use. The reason is clear to most of you, and that is, that the plants feed upon nitrate nitrogen to the best advantage. It is in the best form in the nitrate. Give nature time, and she will make nitrates out of sulfate of ammonia, out of dry blood and out of barn-yard manure, but it takes time.

If we want to get spinach or roots or a crop of asparagus early in the spring, nitrate of soda is very much superior to sulfate of ammonia or dry blood. We have found in our experience, when it comes to tomatoes or corn or second crops of spinach or beets, the sulfate of ammonia gives as good and sometimes better results than nitrate of soda. You see the reason. The nitrate of soda is ready to feed the crop you put it on, hence it is important for the crops that make their growth in the early part of the season. The dry blood

may answer for the later ones, because nature will have time before they need to feed upon it to work it over and convert it into the form of nitrates.

I am tempted to say one thing more about corn. I want to call your attention to a set of photographs that I showed to a few of you this morning. I am more and more amazed, the longer I continue experiments with the corn crop, to note the very close dependence of this crop on all soils, not simply on the Amherst soils but on all soils, upon a liberal supply of available potash. I am further more and more amazed, the longer I experiment with corn, to note the extent to which it can make an excellent crop, although you do not apply to the soil much nitrogen in any form. I have a series of photographs showing this in a marked degree. One illustrates the growth of a crop on one-twentieth of an acre. On one of the plots in this field, during eleven years we had applied only muriate of potash and dissolved bone-black in moderate amounts, one hundred and sixty pounds of the former and three hundred and twenty pounds of the latter to the acre. We had a magnificent crop of corn on that plot. It amounted to about sixty bushels of shelled corn to the acre; it was almost as good a crop as was produced on another plot in the same field where every year for the eleven years we have applied five cords of barn-yard manure. Why is this? It is another generalization. Corn is a crop that does not make very heavy demands on the nitrogen supply until hot weather. It does not grow very fast until into July. Previous to that time, nature has worked over the organic stores of nitrogen in the soil and made it into nitrates, and the corn can depend on that to a great extent. Some have wondered if corn is not able to take that second step into the air and get nitrogen. Perhaps it can. I do not know. The crops that make their chief growth in the latter part of the season do not need to have as much nitrogen supplied to them as others.

Corn grown under the right conditions is one of the most splendid crops we can grow in this country. I heartily agree with the sentiment that corn is the very best gift of God to the American people. I sometimes wonder if there is not considerable room for improvement in the way in which you

manage it. I think there is. Acting upon the few hints which I have given you to-day and other hints which have been put in writing, I feel confident that you can save largely in the cost of raising corn.

One other point. Some nine years ago I took an acre of fair soil, medium loam, and divided it into four equal parts. and began manuring the first quarter with six cords of manure; the second with three cords and one hundred and twenty-five pounds of muriate of potash; the third like the first; and the fourth like the second. The same experiment was twice repeated. I have kept it up, growing corn all except two years out of the nine. Those two years the land was in grass, sown the previous summer with the corn. Now for the results. We have obtained almost exactly identical crops from the two kinds of manure, but the full amount of manure costs about seven dollars an acre more than the lesser amount and the potash. This year we got a little more corn on the lesser amount of manure and the potash than where every year we had been putting six cords. After about three years I found that half the amount of manure and the potash was not keeping up, and I raised the amount of manure to two-thirds, so that for the last five years two quarters have had six cords of manure and the others four cords and the potash.

Question. What value do you place on the manure?

Professor Brooks. Five dollars a cord on the land. I believe this is an important point to you farmers who have to study the economies of farming closely. The lesser amount of manure with potash will give you in the first place a good crop of corn, and then when you seed to grass or clover you get a better crop than when you use manure alone. That was so in the two years in this experiment, when the land was in grass and clover. And it is to that fact largely that I now attribute the fact that this year we have more corn on the lesser amount of manure and potash than on the manure alone. The corn this year has been feeding on the rotted stubble of the clover.

Question. Have you used nitrate of soda on wet land, — mucky land?

Professor Brooks. No, because we have no mucky land.

We have a large flat field that is rich in legumes and vegetable matter, almost clay-like, and we used nitrate of soda there with satisfactory results.

I will tell you something about the soil where the bone meal gave good results. It is a kind of a medium loam; a good fair amount of clay, — between what you might pick out as the best of corn land and the best of grass land; a good soil for average crops. It is well drained. That soil with bone meal applied since 1884 gave us a crop of corn amounting to over thirty tons to the acre.

Mr. Andrew H. Ward (of Boston). I concur with the speaker fully in what he said in his able address. It covered the ground fully so far as the use of commercial fertilizers is concerned. But there is one point to which the professor has not referred; that is, the cost of fertilization, and that is an all-important point to the farmer. Manure to the farmer is what capital is to the merchant. A farmer can no more carry on farming operations profitably without manure than a merchant can carry on business without capital. The merchant may go into the market with borrowed capital to do his business, but, if he has to pay an exorbitant rate of interest, it is only a question of time when he will fail. The farmer may go into the market and buy fertilizers, and, if he pays an exorbitant price for them, he does not get value received, and is running deeper and deeper into poverty as long as he goes on.

I will refer to the report of our former secretary. He said in one of his reports that at the price farmers were paying for commercial fertilizers in the market, the manure from one well-fed cow for twelve months was worth more than forty-five dollars. It was no mean addition to the milk and butter product of the cow, and should be counted as a part of the income. The farmers can see from this that they are paying three times the amount of money for fertilizers that they should pay. Take our experiment stations that our farmers so thoroughly rely upon, and that have done so much good in various lines and in other lines have done so much harm. The experiment stations add twenty per cent to the market values of fertilizers. Do the farmers get twenty per cent added to the market quotations of their

potatoes, corn and other things? Do you expect the papers or anybody to raise these quotations twenty per cent? It is all folly. But your experiment stations, instead of adding twenty per cent to the market value, raise the price one hundred per cent. Think of it, gentlemen! It is a conspiracy against the farmers. It takes only three to make a conspiracy, and there are five of these stations in it.

Gentlemen, you may think what I say is extravagant, but if you will call upon me I will substantiate what I have said by proof that you cannot doubt.

The fertilizer manufacturers are in the market to sell their fertilizers. The values are raised for them one hundred per cent. They are not satisfied. They want a trust. They are not satisfied with the one hundred per cent that the experiment stations add for them. They add in addition all the way from thirty-seven and a half per cent in New Jersey to fifty per cent in New York. Then, where does the farmer stand? If anybody doubts my word, I wish them to raise a question.

Professor Brooks. I understand there is an opportunity for questions. What value is it that the experiment stations start and then raise twenty per cent?

Mr. Ward. If you will let that question go for a few moments, I have a list of ten questions that I want to propound to you.

Our friend from Rhode Island stated some time ago that the stations have called the attention of the farmer to the fact that the only absolutely safe way in general to buy fertilizers with a surety of the quality of the materials they are buying is to buy the individual ingredients and mix their own goods. Now, that is all true. When the experiment stations give analyses to the dealers in fertilizers, the farmers give full faith and credit to them. But we are told by the essayist that when they give the analyses of the nitrogen in the fertilizers, it may be worth fourteen cents or it may be worth three cents; they cannot tell, but they assume — people do not assume when they know — they assume it is of the highest quality.

The Connecticut station says: "These valuations, it must be remembered, are based on the assumption that the nitro-

gen, phosphoric acid and potash in each fertilizer are readily available to farm crops." They assume that. "Chemical examination can show pretty conclusively whether this is true in regard to potash. There is less certainty in regard to phosphoric acid, while chemical examinations, as they are usually made, give little or no clue as to the availability of the organic nitrogen in mixed goods."

Why don't these stations say, "There is so much we know and so much we do not know?" Why do they assume anything? Let the farmer assume for himself.

Now, I will not take your time, but I want to read these questions, to bring the thing to a head: —

1. Is nitrogen of more value per pound in barn-yard manure than in fine or coarse ground fish scraps, cotton-seed meal or castor pomace?

2. Is nitrogen of more value per pound in fine than in coarse ground fish scrap?

3. Is soluble phosphoric acid of more value when made from bones than that made from phosphate rock?

4. Why is it assumed by the experiment stations, in their valuation of mixed fertilizers, that they are composed of the best and highest cost ingredients?

5. Who does the assumption benefit, the farmer, or the manufacturer?

6. For what reason does the experiment station fix the trade value of fertilizers and fertilizing material or ingredients one hundred per cent above the wholesale market price of these articles?

7. Why do not the stations give the quotations from the trade journals of the market prices of fertilizer ingredients?

8. Under whose directions are these fictitious valuations made?

9. On what basis are the prices fixed?

10. By whose authority and under what law are these fictions published?

Does acid or superphosphate of lime, soluble in distilled water, become insoluble within twenty-four hours on its application to the soil?

I will give you one thing more, and then I will give an opportunity for reply.

When I make such charges as I have made to-day, I am too old and not yet foolish enough to make these statements unless I have the stations themselves to back me up. I quote from the Connecticut report for 1879, page 55: "The first wholesale cost of organic nitrogen is but a little more than one-half what the station valuation allows as the fair retail price. . . . During the past summer the unit of ammonia in fish, blood, etc., has been worth, in New York, but from $2.30 to $2.60. At $2.50 per unit of ammonia, the wholesale price of nitrogen would be 10½ cents per pound, with, in general, several per cent of phosphoric acid thrown in. Now, what justifies the station in valuing this same nitrogen when it comes into our retail markets at 20 cents per pound, and at the same time allowing several cents per pound for the accompanying phosphoric acid? The station only can answer that the retail market justifies the trade values it employs, and would, so far as many of the superphosphates and all the guanos other than Peruvian are concerned, justify trade values higher than it has employed."

Professor Brooks. In order not to take more of the time of the audience than is necessary, it is desirable that some one who is thoroughly competent at all points to answer these questions should assume the task. As Mr. Ward has called upon me, I will say that in my work in connection with the experiment station I have nothing to do with fixing the trade values of fertilizers. Professor Wheeler can give you short, pointed answers to these questions, which I feel sure will be satisfactory; and in the interest of the audience, because of the lack of time, I am going to ask him to do it.

Doctor Wheeler. I am ready to answer any legitimate questions, if desired.

In regard to the value of fertilizers; ten or fifteen years ago the farmers were paying a good deal more a ton for their fertilizers than they needed to pay if they would buy the ingredients at the lowest price in the open market and mix the goods themselves. They have been taught a lesson, and to-day they are buying the ingredients and mixing them in large quantities. Some are making contracts to have them mixed at the factories, and sending men to the fac-

tories to see that they are properly mixed. They buy where the goods are offered to them at the lowest prices.

I will say that at the present time the experiment stations and the agricultural colleges in this country have taken the ground that the farmers are so much better informed than they used to be in regard to fertilizers that the commercial values may be abolished. We have pointed it out repeatedly in our bulletins.

Attention has been called to phosphoric acid. Had the gentleman read the bulletins, he would have known that the stations have taken the position that they could not tell everything about it; that they would tell what they could, and wished they could tell more. We cannot tell many things that we would like to.

I think the gentleman's argument has entirely dropped out. We want the laws changed as quickly as we can get them changed. They have been of great good in the past, but are outgrown, and now is the time to take a farther step in advance.

In reply to the questions: —

1. The question is not explicit. We have two values for everything. One is the commercial value, — the price in the market; the other is the agricultural value, — what it is worth to the farmer. You cannot say any particular thing has a definite value. It has a value for one man, and for his neighbor it may have twice the value. That is the agricultural value, and no one can fix it. The commercial value is the price offered in the market, and I cannot say as to that value, because they are so variable in composition. I do not think any man can answer that directly. It depends upon the food consumed by the animal.

2. Grinding increases their value.

3. No, and the experiment stations have repeatedly pointed that out.

4. The only thing to do is to give a valuation on the supposition that they are composed of proper materials. The farmers cannot be sure of not being defrauded unless they have confidence in the manufacturers. If they have not, let them buy the ingredients at the lowest price and mix

them themselves. That has been the advice of nearly all the stations, — a fact that the gentleman cannot dispute.

5. That assumption benefits the honest manufacturer. Any other assumption would benefit the dishonest manufacturer. I am in favor of the honest manufacturer.

6. The question sounds very well. It is practically out of the question, because the stations and colleges are in favor of abolishing the commercial valuations. We are going to have the law changed as soon as we can.

Adjourned at 12.20 P.M.

Afternoon Session.

The meeting was called together at 1.30 P.M., Mr. John G. Avery, delegate from the Spencer Farmers' and Mechanics' Association, being in the chair.

Secretary Stockwell. Before the address of the afternoon, I would like to read a vote of thanks which has been adopted by the Board of Agriculture. It is as follows: —

That the thanks of the Massachusetts Board of Agriculture be tendered to the Union Agricultural and Horticultural Society, to the Westfield Board of Trade, to the Westfield Grange, to the trustees and officers of the Methodist Church for so kindly opening their spacious audience room for our overflow meeting yesterday, and to the people of Westfield and vicinity for their cordial co-operation and aid in making this "country meeting" of the State Board of Agriculture one of the most delightful and profitable meetings in its history. We shall carry away the remembrance of these kindnesses in grateful hearts, and we hope our session in this lovely town has brought something worthy and profitable to be remembered by each and all who have contributed to its success.

The Chair. At the close of this winter meeting, that has been so admirably attended and that has been so successful, Providence has smiled upon us and given us pleasant weather for the occasion, and every one feels delighted with their trip to Westfield. We have a speaker this afternoon who is to speak to you on a matter that is exciting a great

deal of interest throughout the whole country, and I have no doubt that you will be greatly interested in it. We farmers in the past have felt as though the subject of "getting trusted" was of great importance to us; but this subject is "Trusts and their relation to the farmers." I take pleasure in introducing to you Dr. C. S. Walker, professor of political economy, Massachusetts Agricultural College.

TRUSTS AND THEIR RELATION TO THE FARMERS.

BY PROF. C. S. WALKER OF AMHERST.

A thorough discussion of our subject, "The trusts and the farmer," makes it necessary to consider the origin and development of the trust; its advantages and disadvantages; and then remedies for its evils, and means of utilizing its advantages.

I. During the civil war there was a great demand for manufactures, greater than our home industries could fill; hence men and capital were withdrawn from agriculture and employed in manufactures. A high tariff, rendered necessary for revenue, raised prices and protected American manufacturers from foreign competition. An inconvertible paper currency also increased prices. Manufacturing became very profitable, and many manufacturers grew rich. But at the close of the war the home markets were supplied, and fierce competition among American manufacturers set in.

The first to succumb were individual manufacturers. A partnership composed of several men could beat the individual, commanding more skill and more money. Then partnerships succumbed to corporations. In case of bankruptcy the partner may lose all, but the stockholder loses only his stock. Besides this advantage, the corporation has many other advantages over a partnership. No individual, no mere partnership can long hold out in a struggle for existence with a corporation. Then came fierce competition between different corporations for the control of the market for their products. Every means was tried to get the custom of rival corporations. Advertising, the employment of drummers, the presentation of chromos and other gifts to the buyers, other shrewd contrivances, were constantly employed. Various methods of cheapening the cost of production were used,

— the invention of new machinery, the most minute division of labor, secret processes, reduction of wages, the importation of cheap labor and of skilled labor. In this way Mr. Havemeyer testified that he, between 1875 and 1880, succeeded in driving twenty-five refiners of sugar out of business, and secured for his corporation the business of refining fifty-five per cent of the sugar used in the country. The plan of each corporation was to create a demand for its product, and then keep the control of the market for it against all competitors.

Soon it was discovered that the railroad was a powerful ally in this contest. The corporation that could secure an advantage over competitors in the transportation of its raw material on one hand, and of its finished product on the other, was supreme. So the fight went on. The railroads soon found out their advantage, and sold themselves to the highest bidder. The corporation that owned or controlled a railroad could of course drive less fortunate competitors out of business. Then the fight became a contest between railroads, or over railroads. The small corporations were destroyed, the large ones remained. The fight between these became so fierce as to threaten mutual destruction. At this stage a new idea was discovered, — the idea of the trust.

An illustration will make some things plain. Three corporations, A, B, C, supply the demand for 3,000 barrels of sugar within a certain period, each producing 1,000 barrels; but in course of time it happens that A makes a profit of $1 on each barrel, B, 66⅔ cents, C, only 33⅓ cents. A's profit, therefore, on 1,000 barrels, is $1,000; B's, $666.66; C's, $333.33. But if A could secure the custom of B and C, and supply the whole demand, A's profit would be $3,000 instead of $1,000, — an end greatly to be desired. How shall A secure the custom of B and C? The only way of competition was to drive B and C out of business. But to drive is to fight, and to fight is expensive and very unpleasant. Profits wrested from B and C must be paid to drummers, to newspapers for advertising, to customers in prizes or in reduced prices. Suppose, now, that A should pay C $333.33 for its business, so that C should turn over to A its order for 1,000 barrels of sugar; A will then make 2,000 barrels, and,

after paying C, will have $1,666.66 profit. Let A then take the $666.66 increased profit and with it buy the business of B. Then A will produce 3,000 barrels, and, after paying B and C $1,000, will have $2,000 left, thereby doubling its own profits. By this means C is satisfied, B is happy, and A is making twice what it did before, and, having now the whole business to itself, is in a position to extend and improve it to a marvellous degree.

Such possibilities, when once clearly seen, led men to substitute combination for competition, and the trust came into existence. Fierce competition brought corporations to the brink of bankruptcy. A few of the leading corporations sent their managers to confer. The question discussed was, "How can prices be kept from falling, and how can profits be once more secured?" The answer was, "Let us form a trust."

The best managers were chosen trustees. In their hands was placed the stock of the several corporations combining, and to the stockholders were given in exchange trust certificates in amount of sufficient value to amply pay for the stock surrendered. The trustees then have the whole business in their hands, to manage it as they please. They are industrial dictators. Under their management competition ceases; the business prospers; the cost of production is smaller; prices increase; profits are large; on each share of the trust large dividends are paid.

This is the trust in its original form. A corporation is a body made and recognized by the law, capable of suing and being sued, but the trust had no legal status. It could have no standing in the courts; it could not make or enforce contracts; it was a conspiracy to create a monopoly. At the first real attack in the courts this form of organization fell to pieces; hence reorganization was necessary. The individual corporations were dissolved. The stockholders formed themselves into a new corporation, to which the property and business of the old corporations were transferred. This huge monopolistic corporation, organized according to law, is what is now meant by the trust. The name remains as a convenient word to designate the old organization in a new form, seeking the same ends.

II. What are the advantages of the trust?

1. The sugar trust refines as much as eighty per cent of the sugar used in the United States; the Standard Oil Company supplies the most of the oil in use; and so with all the other trusts, — the aim is to produce the greater part of their particular commodity, and so control the market.

2. The trust commands the services of the best *entrepreneurs*, or captains of industry. By closing many establishments, the trust can select the best talent for all parts of its business. It has ample funds at its command to reward the best men in proportion to the responsibility assumed. When the great corporation is fully established, it becomes itself a first-rate training school for the education of the highest executive ability. When the president of the great Pennsylvania Railroad suddenly dies, there is another all ready to step into the vacancy, and the affairs move on smoothly without a break. "The King is dead," — "Long live the King." These are sayings applicable to the industrial world as well as to the political realm.

3. The trust commands the services of the very best workmen. Out of the hundreds of men thrown out of employment by the closing of rival or inferior establishments the trusts may select the best laborers for its purposes.

4. The trust can fix wages as it deems best. The great advantage of the trust is, that by its superior organization it saves labor, producing its product with fewer men. This causes the supply of labor to be greater than the demand. Under such circumstances strikes on the part of laboring men have little probability of success. Thus the trust secures the best labor, in such quantity as it needs, at the lowest cost. It is never obliged to pay a skilled laborer high wages to do common work, for division of labor is so complete, that all simple and easy tasks may be done by cheap labor.

5. The trust commands an unlimited amount of money. Last year the Pullman Car Company paid its regular dividends of two per cent quarterly, August 15 an extra dividend of twenty per cent in cash, and in October another dividend of fifty per cent in stock. Rumors having transpired that the Pullman and Wagner companies were to com-

bine, Pullman stock rose in the course of a few weeks from $165\frac{1}{8}$ to 205. Such facts make the public anxious to take all the trust stocks they can get. In one day, when the sugar trust put its stock upon the market, 70,000 shares were sold, the price going to 120. During this past year new corporations have issued stock and bonds to the amount of more than 3,000 millions.

6. The trust commands the necessary raw material at the lowest prices. Being almost the sole buyer, it can dictate prices. If it thinks best to produce its raw material, it can do so. Spreckels owns great sugar plantations in Hawaii, and the Standard Oil Company owns oil wells.

7. The trust commands the best means of transportation. The Carnegie Steel Company, having an annual output of 4,500,000 tons, can afford to secure the service of the best cars, of immense engines, of huge whaleback steamers, and can procure very low rates for transportation of ore and of steel. In the transfer of intelligence by mail and telegraph and telephone it possesses peculiar advantages, by which it keeps informed as to the conditions of the markets of the world, so as to take advantage of every favorable change and to prepare for every adverse condition.

8. The trust commands the best localities for its business, whether it be manufacturing or trade or transportation. The great railroad combination controlling many lines may carry its freight over the easiest grades and its passengers over the shortest routes. The great department store syndicate may locate its store, or stores, in the very best place. The factories may be located where all things are most favorable: steel works at Pittsburg; paper mills at Holyoke; coarse cotton mills in the south, near the cotton fields, where daylight is plenty, climate warm, fuel cheap, and labor docile and to be procured in abundance and at little cost.

9. The trust commands the best machines. A small company whose output is little cannot afford the best machinery, which is costly. The first cost of the plant would not be made good before it would be necessary to procure new machinery. But, where the value of the products amounts to millions of dollars annually, the very best machinery is found to be the most profitable. A man, a part-

nership, a small corporation is short-lived, — it cannot therefore invest capital except for immediate returns; but the gigantic monopolistic corporation makes contracts for ninety-nine or nine hundred and ninety-nine years. Such a railroad combination is not required to build temporary structures, but may build with steel and stone that which shall last a thousand years.

10. Thus and in other ways does the trust prevent waste, which small concerns cannot accomplish. The utilization of the waste products of gas companies, of oil companies, of meat packers, sugar refineries and of other large establishments has become the great source of marvellous profit. It secures also a great saving of time, and time is money. The time of the working man is saved, and the time during which machinery lies idle is shortened. Recent contracts for bridges and for locomotives were secured in England by American companies, because the American company required only days instead of the months asked by the English. If a machine can be run sixteen hours a day, instead of eight, the interest on the capital is lessened nearly fifty per cent, as counted in the cost of production; or we may say that in the given time the machine will earn twice as much. The larger the product of a factory, the less must be the cost of each particular article. One can make ten thousand hats much more cheaply per hat than it would be possible to make a single hundred.

11. But, great as is the saving in the cost of production, there is a much greater saving in the cost of selling the product when once made. Heretofore, to sell an article cost much more than to make it. Sewing machines that sold for $75 might be made in quantities for $15. The $60 went to the jobbers and wholesale dealers and retail merchants and agents, for freight and advertising, for credits granted and for debts lost. The trust reduces the cost of selling to a minimum. Mr. Bradley, of the distilling company, testified that the trust saved $1,000,000 by dispensing with the services of three hundred travelling salesmen.

12. Producing its special commodities in large quantities, and possessing virtually a monopoly, the trust may fix its own price. This, from its own point of view, is a very great

advantage. It enables the company to prevent the price from falling so low as to bankrupt the producer, and from rising so high as to check the demand by impoverishing the buyers.

We must conclude, then, that the trust is master of the situation, and is therefore able to produce its commodity under the most favorable circumstances, as cheaply as it can possibly be made and yet of the very best quality; and thus to sell it at the least expense for the highest price that the demand will justify. As against the individual, or the partnership, or the small corporation, the trust has the greatest advantage. In its line it is autocratic. Left to itself, it eliminates competition and enjoys a monopoly. In its particular line of business the trust is the perfection of the combination of capital and of the organization of industry. It is the most complete instrument for the production of wealth the world has yet discovered.

Properly administered and justly conducted, as it might be, the trust is a great boon to humanity. The Standard Oil Company, *properly administered* and *justly conducted*, must produce the greatest possible amount of illuminating and lubricating oil, of the best quality, at the least cost of money, time and effort, and sell it to the greatest possible number of consumers at the lowest possible price. But what is this? Is it not to turn darkness into light, coldness to warmth, death to life, and to make friction less in all the turning points of progress? The sugar trust, *properly administered* and *justly conducted*, must produce the greatest possible amount of sugar of the best quality, at the least cost of labor, time and money, and sell it to the largest number of consumers at the lowest possible price. But what is this? Is it not to sweeten and warm humanity? Sugar, you know, is mostly carbon, and that warms the human heart and sweetens life. Suppose the salt trust, the steel trust, the coal combination and all of the other monopolistic corporations, properly administered and justly conducted, should do their best, — what must follow? Then should we have an abundance of all the best commodities, necessaries, comforts and luxuries of life, produced at the least cost of time, labor and money, distributed to the masses of the people for the least price.

We cannot therefore but believe that trusts have come to stay, and that the wise thing for the people to do is to multiply them more and more, and push the productive capacity of each to the full extent, until we have a surplus of every commodity that can minister to human need. The people should do all this. The people, in the sovereign capacity of the State, should create the trust and control it, keeping it from doing harm, and compelling it in all things to seek the general welfare, never becoming the instrument of private greed.

III. Such are the advantages of the trust, and its possibilities. But, on the other hand, there are great disadvantages and serious evils connected with the trust, especially in the early stage of its development, before the people have learned how to control it. If the trust's power for good is great, its power for evil is tremendous.

1. The necessary tendency of the trust is to throw both manual laborers and brain workers out of employment. In this respect it is like new machinery and improved processes. Hence it follows that in the nation there is a great army of the unemployed and in the world a host of idle men. The department store shuts up many retail and wholesale stores in city and country, in all lines of business whose products are sold by the syndicate. So it is with all the trusts. This evil, though serious for the time, yet in the end will be remedied by the fact that the increased product of the trust will create new wants which in turn must create a demand for more labor. This remedy must be thoroughly applied; the laboring man, manual or brain worker, skilled or unskilled, must be taught the value of leisure and how to utilize it, instead of abusing it to the injury of the man. The man whose daily work is to perform some minute operation assigned him in the remarkable division of labor must use his leisure so that his manhood shall not be dwarfed and his versatility destroyed. He who knows only how to make the hundredth part of a watch is at the mercy of circumstances; so also is the man who is a mere adding machine. The man must be more than his occupation, — he must be above his employment; then, when one thing fails to afford him a living, he can turn to something else. The mobility of labor must take the place of immobility.

2. The power of the trust is so great as to become dangerous. Its legitimate profits are so immense that the wealth already acquired tempts the managers to adopt illegal and unjust means to accomplish their purposes and add to their wealth. The temptation is to charge the consumer an extortionate price for the commodity; or to limit production, hoping thereby with less work to make an equal or greater profit from the sale of a less quantity of goods at an enhanced price; or to continue the use of inferior machinery or processes, when new inventions and methods would make the service better or the product cheaper; or to unjustly use its working men, paying them low wages, neglecting their safety, using up one lot of men and then turning them off to take a new lot of citizens or aliens in their places; or to take illegal advantage of competitors to drive them out of business; or to use unjust discrimination between different customers or patrons, promoting the interests of one at the expense of another, developing one community at the cost of another, always of course for a consideration; or to defraud the public by watering the stock and selling it at a high price to innocent buyers, only to manage the corporation so that the price of the stock shall fall greatly, so that the officers of the trust may buy it back again to repeat the process over and over; or to sell out the trust to alien capitalists, whose only interest is to run the enterprise so as to make the largest dividends, regardless of whatever untold evils may come to employees, to the minority of the stockholders, to the consumers, to the citizens of this or of following generations; or to corrupt municipal councils, State legislatures, the national government, political parties, or even the people themselves, by bribery and sundry other devices known to the shrewd manager; or to endanger the State by evading its just burden of taxation.

These ten evils are by no means mere phantoms of the imagination, but are very real. A careful student of the origin and development and management of trusts, as revealed in the history of the last twenty-five years, set forth by the sworn testimony of promoters, managers, stockholders and others directly concerned, given in courts and before various investigating committees, finds that each of the evils

mentioned has been perpetrated again and again, and all taken together constitute a serious menace to the welfare of all classes of the people, to the safety of the State and to the salvation of society. The extent of the evils and the danger of the crisis have not been exaggerated; both demand the serious consideration and determined action not only of the farmers but also of all good citizens.

IV. What, then, must be done, and done speedily and thoroughly, to save for mankind the advantages of the great monopolistic corporation, and at the same time save society from the terrible evils which the tyranny of the trust may inflict?

1. The attempt to destroy the trust is both futile and foolish. It is too late now to destroy the trust, — it cannot be done. If it could be done, the result would be to deprive society of the most efficient instrument for the production of wealth that the world has yet produced, — a consummation that would be a calamity equal surely to the evil the trust, if left alone, would inflict.

The one thing which can be done and must be done is that the people shall demand, and enforce the demand, that the trust shall be wisely administered and properly controlled for the promotion of the best interests of all parties concerned.

The parties concerned are the managers of the trust, the stockholders, the employees, the consumers, the community and the State. Each of these parties has rights and has duties, the one commensurate with the other. Much of our trouble with trusts has arisen out of the neglect of certain fundamental truths. Let us here emphasize a few of these. First, we must never forget that the corporation, great or small, is the creature of the State. The State gives the corporation its being and preserves its existence; without the constant support and protection of the State the corporation could not do business, could not exist. All natural monopolies, such as are enjoyed by railroad, telephone, telegraph, gas, electric light and power companies, involve the right of eminent domain, the power to seize private property for public uses; which power inheres alone in the State, and by the State is granted to corporations on the condition that, and

so long only as, the corporation shall promote the public good. All corporations are created by the State to promote the public good. What the creator has created it can, if it will, destroy. When the creature ceases to fulfil the end of its creation, it should be destroyed. It follows, then, very surely that the corporation which persists in evading taxation, in breaking the law, in corrupting municipal, State and national governments, in substituting private greed for public policy, is its own worst enemy; it is fast rushing on to self-destruction.

One thing the farmers of Massachusetts may do, in the assurance that they will be supported by the farmers of the whole country and by all good citizens and that they cannot but succeed, is to demand that no trust shall defy or evade or disobey the law of the State, but shall be strictly held to the performance of its duty, on the penalty of forfeiture of its charter and dissolution, all its franchises reverting to the State.

2. Secondly, we must not lose sight, nor allow corporations to lose sight, of the truth that the community in which the corporation does business is the factor to which is due a large share of the profits of the corporation. The value of the franchise, as of land, depends largely upon the character of the community. If population is increasing, if intelligence is universal, if morals are good, if the people are thrifty, if public opinion and sentiment and will are in favor of law and order, then land values increase and franchises become more and more profitable, the stock doubles its dividend-paying power; but, if the contrary conditions are prevalent, then no skill on the part of the trust, no combinations of capital, can prevent loss and bankruptcy. The community, therefore, is a legitimate partner in every corporation, and its rights must be respected. The sentiment so forcibly expressed in the words, "The public be damned," if tolerated, must prove the total destruction of the corporation permitting it. The good-will of the public, so zealously sought by advertising and valued so highly when involved in trade-marks and reputation, is at once ruthlessly annihilated.

3. Thirdly, all should never lose sight of the fact that a corporation exists for the supply of the demand of the con-

sumers of the product, or for the service of those whose money supports the corporation. A railroad exists not for the benefit of its stockholders and managers, but for the service of the persons who ride upon it and who ship their freight over it; the stockholders and managers are paid for serving the patrons of the road. The sugar trust does not exist for the sole benefit of its president and directors and stockholders, but for the benefit especially of the consumers of the product. A bank does not receive its charter that its officers and stockholders may grow rich, but that the depositors and business men who borrow of it and lend to it may be faithfully served. The corporation that serves its customers, patrons, consumers of the product, promoting their best interest, thrives; the corporation that advances its own selfish interests, at the expense of the consumer, is digging a pitfall for its own destruction.

At what price must a monopoly sell its commodity, — what shall it charge for its service? Concerning those trusts whose product is such that the demand falls off rapidly as the price is increased, the answer is plain. The trust can fix what price it will. If the price is too low, it loses money. If the price is too high, it will lose more than it can gain. Experience shows that immense sales at a small profit on each article are vastly more profitable than a large profit on each commodity but with small sales. By a great economic law in such cases the interests of the trust and of the consumer are identical. Hence the prices of oil and sugar and such commodities have been greatly reduced.

But there are other commodities and services of such a nature that the demand does not change greatly when prices are decreased or increased. Sugar is something everybody wants, but a telephone is wanted only by comparatively a few. Hence the telephone company in New York City finds it more profitable for the time being to charge the few who must have a telephone $240 a year, than to charge a greater number $100 a year. In this instance the Board of Trade appealed to the Legislature for relief, on the ground that the company had received its patents and right of eminent domain and charter from the State, not for the purpose of extortion, but to promote the public good, — a ground per-

fectly good in law and equity, but of no avail as yet, because of political reasons. But the end is not yet. If the trust is obstinate, its large profits will inevitably lead to the creation of a rival corporation strong enough to compel it by competition to reduce its prices. If it buy up its rival, another and another rival will arise to vex it, until the prices are reduced within such limits as to make it no longer worth the while for capital to compete. Moreover, there is a limit to which the patience of the people can be provoked and public opinion can be ignored.

4. Fourthly, it will not do to forget that the employees of the trust are parties in interest. Though they receive wages instead of dividends, their hearty co-operation and their efficiency are essential to the success of the corporation. If the best machinery is necessary, the best workman to run the machine is required. If the organization of the various departments of the trust is more complex and delicate than the huge engine, the faithful and able manager must be found who can be trusted to do his part. A hungry, sleepy, exhausted motorman wrecks his car, an overworked locomotive engineer wrecks his train, a neglected captain of a steamship may wreck his vessel. If the trust itself cannot be trusted, it must soon come to pass that its most trusted employees will prove faithless or incompetent. Strikes are detrimental to the corporation, as well as to the working men. One great strike teaches the corporation that prevention is cheaper than victories, industrial peace is more profitable than war.

It is possible for a trust to employ ignorant immigrants in unskilled labor, at starvation wages, and then, when used up, turn them loose as paupers or vagrants upon society, and take on a new gang to repeat the process; but in the end it has not been found profitable. Such a policy sets social, moral, political and economic forces into action which soon cause the corporation to consider its conduct and reform its action.

5. Fifthly, the interests of the State, the public, the consumers and the laboring men are one in the matter of demanding that the trust shall be wisely administered and properly controlled; but these parties are many, and it takes time to

move them to action. Public opinion must be enlightened, public sentiment stirred and public will evoked before the State will act resolutely, the public insist upon its rights, consumers co-operate for mutual protection, and working men and salaried employees and small business men join together in wise and efficient effort. In the mean time, the abuses of the trusts continue, and dangers threaten. One great cause of the delay in the movement towards reform is the placing of thousands of shares of the stock of great monopolistic corporations among the people, where they will do the most good in strengthening the power of the trusts. The stockholders who get large dividends are slow to see abuses on the part of managers, and loth to protest when evils are shown them; the multitudes who have invested their savings in stocks and have lost heavily keep still, lest their shame be made public and they lose the little values that may yet remain to them; while other people who speculate in stocks on margins are prevented from joining any movement to check the audacity of corporations.

But the time has now come when the rights and duties of all stockholders should be made plain. The stockholders are the owners of the corporation, and should be held responsible for the deeds of directors and officers. But the number of stockholders of a large corporation is so large, and they are often so widely scattered, that any efficient action on their part for the reform of abuses against themselves or others is difficult to secure. They are for the most part kept in ignorance of the policy and management of the corporation. The minority can do little or nothing when the majority of the stock is in the hands of a few. The directors are elected by the stockholders, and are nominally their servants; but, once elected, their power is supreme. The directors elect the officers, and are supposed to direct and control their actions; but not infrequently it happens that the directors are mere figure-heads, while a few officers manage affairs and run the business, — not for the benefit of the stockholders, but for their own. The inner ring makes fortunes for its members, while the average stockholder may congratulate himself if he does not lose a large portion of his capital invested. Stockholders have been defrauded time

and again by numerous schemes and diverse devices. If any particular part of the business becomes specially lucrative, it is considered too good for its stockholders, and must be given to a company created for the purpose of diverting the profits into the pockets of a favored few.

6. Sixthly, while the rights of the directors and officers are to be secured and ample power and remuneration granted them, they should be made to realize their responsibility, and never allowed to forget that they are the servants, not the masters, of the stockholders, whose wealth is entrusted to their care; of the employees, whose labor they direct; of the consumers, whose demands they seek to supply; of the community, whose good-will is essential to their success; of the State, whose power is the creator and preserver of the corporation of which they are the head. Here we should learn a lesson from England, where directors are not figureheads to delude the public, but men who are held strictly to the performance of their responsible duties, on the penalty of severe punishment for any negligence or misdemeanor.

The one question of vital importance before the country to-day is, Shall this be a government of the people, by the people and for the people, or shall it be a government of the trust, for the trust and by the trust? If the latter gains the victory, then shall we see plutocracy established on the ruins of democracy. If plutocracy is to be avoided, then one of these alternatives must be chosen: —

1. All capital shall be held by the State, so that the State shall be the sole landlord and the sole employer of labor. This is socialism.

2. All natural monopolies, railroads, transmission of intelligence by telegraph and telephone as well as by post-office, gas and electric light and water supply, shall be owned and operated by the government.

3. All monopolistic corporations shall not be owned or operated by the government, but shall be controlled by the government under law, enforced by dominant public opinion, and compelled to subserve the best interests of all parties concerned, — the State, the community, the consumers, the employees, as well as the stockholders, the bondholders, the directors and officers.

Of these three alternatives, the last is by all odds the most likely to prevail. It is the best of all three, and the most practical. The trust is a good thing for those in the ring; the remedy for the incidental evils is not to smash the trust, but to extend the circumference of the ring farther and farther, until it takes in all the stockholders as well as the favored few, all the producers whose labor creates the wealth, all the customers whose money makes the business successful and whose patronage it is desired to monopolize, the whole community, to whose growth the unearned increment of land values and franchises is due, of the State, the silent partner, whose co-operation is the source of untold profits.

It is very clear that the State must control the trust, or else the trust will control the State. If the trust control the State, we have plutocracy, the worst of all forms of government. If the State cannot control the trust, then it will destroy the trust and itself become the landlord and capitalist, and we shall have socialism with all of its doubtful blessings and assured evils. The American people are not yet ready for socialism. Surely they will have no plutocracy. Only one thing, therefore, remains for the State, — it must control the trust. How shall it control the trust? If it be necessary, it will not hesitate to follow the examples of European countries, and seize all natural monopolies and operate them as it now does the post-office. But it is loth to do this. It will not, unless the audacity and greed of such corporations force it to take this alternative.

Can the State control monopolistic corporations, and yet leave them in the hands of stockholders, directors and officers? This is the problem. If the stockholders, directors and officers can be made to see their own best interests, and shall heartily co-operate with the State to this end, the problem will be easily solved.

President Hadley of Yale, than whom I know no better authority in this sphere, says that it is the duty of the universities to train men to manage corporations. He surely is right. To manage a great corporation so as to subserve the best interests of all concerned is a task that demands an honest, able, far-sighted and great-hearted man, — a kingly man in the best sense of the word. With such men as rail-

road kings, coal barons, captains of industry and merchant princes consecrating their genius to the best service of stockholders, laboring men, consumers, community, the State, the glory of the twentieth century must surpass that of all the past, and industrial freedom and prosperity of the people, by the people and for the people become an assured fact.

Here, then, is the farmers' opportunity. In the crisis the farmers of America have never been wanting. Their voice and deeds overthrew slavery and saved the Union. Their voice and deeds to-day should make plutocracy forever impossible, and the trust in reality what it is in name, — a trust reposed in stockholders and directors, to the end that the abundant resources of our great empire and the might of our people's labor shall not be prostituted to private greed, but developed for the people's wealth.

Specifically what measures need to be developed and enforced?

1. The corporation, being a body corporate, created by the law of the State, shall, like any other body, respect and obey the law of the State in which it does business.

2. Each corporation shall report its accounts and its doings to its stockholders, to the State and to the public. Publicity is a great corrector of abuses. The corporation, being a public institution, created and supported by public law for the public service, has no business with dark lanterns and officers who are know-nothings or blessed with forgetful memories. Railroads and banks must report to the State; so should the sugar trust and all other corporations.

3. All stock watering should be strictly prohibited. The laws of Massachusetts are admirable regarding stock watering. Improved as best they may be, they should become the laws of every State. Every share of stock should represent dollar for dollar paid in by the stockholders and expended for legitimate purposes. If the business prospers, and pays 10, 20 or 50 per cent dividends, so be it. Let the value of a share of $25 par rise to whatever it will bring in the market, — to $765, like the Calumet and Hecla Copper Company; let a share of $100 par rise to $4,000, like the Chemical Bank; but never allow a company, because it can pay a large dividend, to double its stock, and, selling the stock, thus

secure the uncertain profits of the future for itself before they are actually earned. This one prohibition would remedy a multitude of evils. It would do much to check stock manipulation and speculation and to protect honest investments.

4. No public franchise should be given or sold to a corporation. The use of the franchise should be allowed the corporation on condition that it pay to the State its fair value, to be determined every ten years by appraisement.

5. Each corporation shall pay its full share of taxation to each State in which it does business, its share to be determined by the amount of property and value of the business done within the State.

6. Each corporation shall be independent of every other corporation, and to this end no corporation shall lease itself to another and no corporation shall own the stock of another. If combination is necessary, one corporation may dissolve, and its property and franchises and obligations be transferred to the other corporation. If one corporation may own or control other corporations, responsibility cannot be fixed, many irregularities may be covered up and evils follow which cannot be remedied. But if each corporation has its special functions defined in its charter, and it be held strictly to the performance of these, the problem of controlling it will be greatly simplified, its rights secured and the discharge of its duties enforced.

7. Uniformity of corporation laws throughout the country is very desirable. Chartering corporations in one State, where the laws are loose, and dictated to please the corporations, and then allowing them to do business in any State or Territory contrary to the spirit of the laws of these, competing unfairly with home companies, has been and is prolific of great evil.

A remedy for this state of affairs and a means of securing uniformity of the organization of trusts and of maintaining ample control over them may be provided. Our experience with national banks affords us a clue to the solution of the problem.

Let Congress pass a law, — there is no constitutional barrier in the way of such legislation, — providing, first, that all common carriers of freight, intelligence or persons from

one State to another must receive their charters from the national government; providing, secondly, that a corporation whose product equals fifty per cent of any product produced in the country may receive a charter from the national government permitting it to do business anywhere in the country under certain proper conditions; providing, thirdly, that a tax, sufficiently high to prohibit their formation, be levied upon all corporations whose product equals fifty per cent of the total of any product produced in the country, if, refusing to get a national charter, they should organize under a State law and receive a State charter.

Such a law would put all trusts directly under the supervision of the general government, and subject them to a power capable of controlling them. It would put an end to New Jersey's lucrative business of furnishing charters to corporations. A company doing business wholly within a State could still get a State charter; if such corporations should abuse their powers, the State could easily discipline them.

Experience has shown that a gigantic monopolistic corporation may acquire such power as to defy a town, a county, a city, — such power as to control a State, even, through means at its own command. But to control Connecticut, or New Jersey, or some single State, is much more simple than to control the United States.

It is very probable that seventy millions of people, represented in Congress, supreme court and the executive department, supported by an army and navy, can control a sugar trust, a Standard Oil Company and any and all the other corporations. It is well within their power to pass and enforce laws compelling corporations to respect and obey the State; to look well after the interests of all the stockholders, of their employees, of their customers and of the community; to make public their doings; to abstain from stock watering; to pay for the use of franchises; to maintain their own independence of any and all other corporations; to pay their fair and full share of taxation.

This problem of the trusts is a new one. The people are just beginning to arouse themselves to a serious attempt to solve it. Public opinion and sentiment are shaping them-

selves. Presently the public will must assert itself and compel obedience, demanding not that trusts shall be destroyed, but that all trusts shall be wisely administered and properly controlled, so that the best interests of all concerned — officers, directors, employees, stockholders, consumers, the community and the State — shall be promoted. The real interest of one of these parties is the interest of all, and the interest of all is the interest of each. Already capable managers of corporations, such as Chauncey Depew and the late Cornelius Vanderbilt, are persuaded of this, and welcome legislation tending to this end.

The farmer's duty, then, is very clear; it is coincident with his interest and his profit to throw all of his influence into the movement for wise administration and proper control of all the trusts.

But, besides this, the farmer must adjust himself and his business to this new industrial instrument, the trust; he must protect himself against its evils and be quick to utilize its wonderful advantages.

Wide-awake farmers are already moving in the right direction. The principles involved in the trust should be applied to agriculture just as far as possible and as quickly as possible, as well as to manufactures, trade and transportation. A milk trust, a fruit trust, a cattle trust, a butter and cheese trust, a grain trust, are among the possibilities. A beginning has already been made in some lines. Combination rather than competition should be the farmers' principle of action. Capitalistic agriculture must win the day against autonomous agriculture.

A single farmer, who is his own landlord, his own capitalist, his own captain of industry, his own laborer, attempting to produce all sorts of crops, one year after another, that his farm may yield, cannot possibly hold his own against a corporation of stockholders with ample capital, cultivating the best land for the special crop, using the best tools, directed by experts, employing the best labor, buying all it needs at the lowest price and selling its product in the best market at the highest price, after securing the best means of transportation at the lowest rates.

Heretofore capital and captains of industry have neglected

agriculture for manufactures, trade, mining and transportation. But these fields of enterprise have for the most part now been filled. Capital and captains of industry must seek new opportunities; they will find none better than American agriculture. The culture of cereals, of tobacco, of cotton, of fibre, of fruits, of flowers, of garden products; the multiplication of flocks and herds; the production of butter, cheese, milk and cream, to say nothing of sugar cane, coffee, tea, valuable woods, rubber, which may be produced in our new possessions in the islands of the tropic seas, under the stars and stripes, offer munificent rewards for the man of brains and brawn, who shall organize corporations and direct them wisely in the work.

Let the farmers of Massachusetts combine their capital, organize themselves into corporations, secure the best directors and managers, and so multiply their wealth thereby, for the benefit not only of themselves, but also of all concerned, — stockholders, managers, employees, consumers, the community, the State. The world moves on. The agriculture of the twentieth century will be a great improvement on that of the nineteenth, and the farmer of the new era will surpass his brother of the olden time.

Secretary Stockwell. I had hoped there would be an opportunity to speak on the paper of the afternoon, but the time has gone by. I hope, as you read it and as you think upon it and as you study it when it comes out in the report, it will have an influence to bring farmers together to realize the importance to them of the trusts of the country as conducted at the present time. Any of the farmers here in Westfield who desire a copy of the report, if they will give us their names we will be very glad to send them a copy.

Adjourned at 4 P.M.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE,

AT

BOSTON.

JANUARY 9 AND 10, 1900.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 9, 1900, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The meeting was called to order by Secretary Stockwell. In the absence of the president and first vice-president, the second vice-president, Mr. E. W. Wood, was called to the chair.

Present: Messrs. Allen, F. H. Appleton, J. S. Appleton, Avery, Baker, Barrus, Barton, Brewster, Bursley, Clark, Crane, Damon, Danforth, Davis, Ellsworth, Goodell, Goodspeed, Hall, Hersey, Horton, Howard, Kilbourn, Lloyd, Pratt, Reed, Richardson, Sargent, Smith, Stockwell, Thayer, Thurston, Whitmore, E. E. Wood and E. W. Wood.

The records of the public winter meeting and of the special meeting of the Board at Westfield were read and approved.

The records of the executive committee, acting for the Board, were read by the secretary and approved, and the acts of the committee were adopted as the actions of the Board.

The executive committee, as committee on credentials, by Mr. W. A. Kilbourn, reported the list of qualified members of the Board for 1900. The newly elected members are as follows: —

Amesbury and Salisbury Society, F. W. Sargent of Amesbury.
Berkshire Society, Wesley B. Barton of Dalton.
Blackstone Valley Society, Samuel B. Taft of Uxbridge.

Eastern Hampden Society, O. E. Bradway of Monson.

Hampshire, Franklin and Hampden Society, Henry C. Comins of Hadley.

Hingham Society, Edmund Hersey of Hingham.

Hoosac Valley Society, Geo. P. Carpenter of Williamstown.

Housatonic Society, Charles B. Benedict of Egremont.

Manufacturers' Society, Oscar S. Thayer of Attleborough.

Marshfield Society, Henry A. Turner of Norwell.

Massachusetts Horticultural Society, William H. Spooner of Jamaica Plain.

Massachusetts Society for Promoting Agriculture, Nathaniel I. Bowditch of Framingham.

Nantucket Society, John S. Appleton of Nantucket.

Weymouth Society, Quincy L. Reed of South Weymouth.

Worcester East Society, William A. Kilbourn of South Lancaster.

The report of the committee was accepted and adopted.

An abstract of the annual report of the secretary was presented, read and accepted.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and adopted.

The report of the committee on gypsy moth, insects and birds was presented at the special meeting of the Board at Westfield, Dec. 6, 1899, and was accepted and adopted at that time.

The report of the Dairy Bureau was read by the assistant of the executive officer of the Bureau, Mr. Geo. M. Whitaker, and was accepted by vote of the Board.

At 12.25 the Board adjourned to 2 P.M.

The Board was called to order at 2.05 P.M.

The report of the committee on Agricultural College and education was read by the secretary of the committee, Mr. W. B. Barton, and by vote of the Board was accepted and adopted as the report of the Board to the Legislature.

The report of the committee on experiments and station work was presented orally by Mr. Edmund Hersey, chairman.

The committee on forestry, roads and roadside improvements, by Gen. F. H. Appleton, chairman, presented a written report, which was accepted and adopted.

The committee on domestic animals and sanitation, by Mr. F. L. Whitmore, presented a written report, which was accepted and adopted.

His Excellency Governor Crane coming in, a recess was taken, that he might meet the members of the Board.

Mr. Brewster offered the following resolution on the death of Mr. Sprague S. Stetson of Lakeville: —

Whereas, In the events of Providence one of our number has been removed by death, who was an esteemed member of this Board, and one who was regarded as a valuable representative of the agricultural interests of the State of Massachusetts;

Be it resolved, That we, the members of the Board of Agriculture, deplore his loss and regret his departure, and, while bowing to the inevitable decree that closed his relations to this organization, we yet desire, in tribute to his memory, to bear heartfelt testimony to his worth as a citizen, to his integrity and upright character, to his superior intelligence and his public spirit and enterprise, which endeared him to all who knew him in public station or in private intercourse.

Resolved, That a copy of this resolution be sent to his family, and placed upon the records of this meeting.

After brief remarks upon the resolution by Messrs. Brewster, Kilbourn, Pratt and E. W. Wood, it was adopted by a rising vote, all present voting in favor.

The secretary notified the Board of the resignation of Hon. James S. Grinnell, and moved that a committee be appointed to draft tribute to his long and faithful service on this Board. The Chair appointed Messrs. Goodell, Kilbourn and Hersey as the committee.

General Appleton moved that the office of first vice-president *emeritus* be created, to be filled by the Hon. James S. Grinnell, if, in the opinion of the executive committee, such is possible, and can be done without inconsistency. General Appleton further moved that his motion be referred to the executive committee, and by vote of the Board the matter was so referred.

The report of the librarian was read, accepted and adopted.

An abstract of the reports of inspectors of the several fairs, prepared by direction of the committee on agricultural societies, was read by the secretary.

Voted, To accept the reports of inspectors.

On motion of Mr. F. W. Sargent, it was

Voted, That, considering the long and valuable services to the Board and the esteem in which he is held by the members, it is our desire that Mr. Wm. R. Sessions, our late secretary, furnish this office with a portrait of himself.

The matter of government aid in gypsy moth work, referred to the annual meeting at the special business meeting at Westfield, was brought up by Mr. Pratt. After remarks by Messrs. F. H. Appleton, Avery, E. W. Wood and the secretary, it was voted to refer the matter to the committee on gypsy moth, insects and birds, with instructions to report a committee to have this matter in charge.

The gypsy moth committee reported Messrs. E. W. Wood, Francis H. Appleton and William R. Sessions as a committee to draft and send resolutions to the Legislature to take action in regard to memorializing Congress, which report was accepted, and the gentlemen named were made the committee by vote of the Board.

Voted, To complete the binding of the catalogues of the library of the Board, authorized at the last annual meeting, at an expense not to exceed fifty dollars.

The secretary reported for the committee having in charge the arrangements for the session of the Farmers' National Congress held in Boston in October last.

Voted, That the thanks of the Board be extended to the committee for their labors.

Voted, That the two members over the number necessary to fill the committees be assigned one to the committee on domestic animals and sanitation and one to the committee on Agricultural College and education.

Mr. Walton Hall extended an invitation to the Board to hold a field meeting at his place in Marshfield, the Daniel Webster farm, some time during the coming summer.

General Appleton moved the acceptance of Mr. Hall's invitation, with thanks, and that the secretary and Mr. Hall be a committee of arrangements for the meeting, and it was so voted.

Adjourned to 10 A.M. Wednesday.

SECOND DAY.

The Board was called to order by the secretary at 10.20 A.M. Mr. W. A. Kilbourn was chosen temporary chairman by acclamation.

Present: Messrs. F. H. Appleton, J. S. Appleton, Avery, Barrus, Barton, Bradway, Brewster, Bursley, Carpenter, Clark, Comins, Damon, Danforth, Davis, Ellsworth, Gleason, Goodell, Goodspeed, Hersey, Horton, Howard, Kilbourn, Lloyd, Pratt, Reed, Richardson, Sargent, Smith, Spooner, Stockwell, Thayer, Thurston, Turner and Whitmore and retiring members Allen, Baker and E. E. Wood.

The records of the first day were read and approved.

Voted, That the Board proceed to the election of officers, with the exception of first vice-president, that office to be filled later by the executive committee.

Election of officers being in order, the chairman declared His Excellency W. Murray Crane president of the Board (by a by-law of the Board the Governor of the Commonwealth is *ex officio* president).

By an election by ballot Mr. Augustus Pratt of North Middleborough was elected second vice-president and Hon. J. W. Stockwell of Sutton was elected secretary.

Election of specialists being in order, the secretary was instructed to cast one ballot, and the election resulted as follows: —

Chemist, Dr. C. A. Goessmann of Amherst.
Entomologist, Prof. C. H. Fernald of Amherst.
Botanist and pomologist, Prof. S. T. Maynard of Amherst.
Veterinarian, Prof. James B. Paige of Amherst.
Engineer, Wm. Wheeler of Concord.
Ornithologist, E. H. Forbush of Malden.

The committee on resolutions on resignation of the Hon. James S. Grinnell reported, by President Goodell, in the form of the following letter: —

BOSTON, Jan. 9, 1900.

Hon. JAMES S. GRINNELL, Greenfield, Mass.

DEAR SIR: — The Massachusetts State Board of Agriculture, in session assembled at their annual meeting, have learned with sincere regret of your resignation from its membership.

They desire to express their deep sympathy in the illness which has led to the taking of this step, knowing that only the strongest necessity would have forced you into severing that bond of mutual affection which has so long united us.

For nearly fifty years you have been our friend, our counsellor, our leader, and now, as we bid you farewell, we can only cry, "My father, my father, the chariots of Israel and the horsemen thereof."

May peace and happiness attend you, and the sunset of your life be even as bright and beautiful as its morn. God bless and keep you always is the prayer of your friends.

In behalf of the Board,

(Signed) HENRY H. GOODELL.
EDMUND HERSEY.
WILLIAM A. KILBOURN.

On motion of Secretary Stockwell, it was

Voted, To elect a standing committee on institutes, rules and legislation, said committee to act conjointly with the executive committee, and these two committees to have power to appoint sub-committees or advise or help forward legislation or adopt rules, when such action is approved by a majority of this joint committee present and voting.

Voted, To amend article 1 of chapter I. of the by-laws, by substituting the word "nine" for the word "eight," in the third line; the word "eight" for the word "seven," in the fifth line; the word "eight" for the word "seven," in the sixth line; the word "nine" for the word "eight," in the seventh line; and adding to the list of committees the following: "9. A committee on institutes, rules and legislation."

Mr. F. H. Appleton gave notice that at the next meeting of the Board he should move an amendment to article 1 of chapter VII. of the by-laws by dividing the article into two sentences after the word "Board" in the third line.

The hearing on the request of the Eastern Hampden Agricultural Society for the approval by the Board of Agricult-

ure of its vote, passed at a special meeting of the society, on Dec. 11, 1899, "That the president and treasurer be authorized to place a second mortgage on the society's property, in accordance with the rule and with the consent of the State Board of Agriculture, for an amount not to exceed two thousand dollars," being in order, the matter was heard. It appearing that the action of the society was according to law and properly advertised, and no person appearing in opposition to the request of the society, it was

Voted, That the Board of Agriculture approves of the vote of the Eastern Hampden Agricultural Society, passed at a special meeting, Dec. 11, 1899, as above quoted, in accordance with the provisions of chapter 274 of the Acts of 1890.

Adjourned at 12.15 to 1.30 P.M.

The Board reassembled at 1.30 o'clock.

Voted, That a place on the committee on gypsy moth, insects and birds be left vacant, to be filled later by the executive committee.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees) : —

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, D. A. Horton of Northampton, John Bursley of West Barnstable, Edmund Hersey of Hingham, Francis H. Appleton of Manchester, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury.

Committee on agricultural societies: W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, Chas. A. Gleason of Springfield, Henry A. Howard of Colrain, Geo. P. Carpenter of Williamstown.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, Oscar S. Thayer of Attleborough, Joshua Clark of Lowell, F. L. Whitmore of Sunderland, Almon W. Lloyd of Blandford.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, John M. Danforth of Lynnfield, John G. Avery of Spencer.

Committee on Dairy Bureau and agricultural products: Messrs. D. A. Horton of Northampton, J. L. Ellsworth of Worcester, C. D. Richardson of West Brookfield, C. B. Benedict of Egremont, H. H. Sigourney of Oxford.

Committee on Agricultural College and education: Messrs. John Bursley of West Barnstable, C. K. Brewster of Worthington, Wesley B. Barton of Dalton, Geo. P. Smith of Sunderland, Alvan Barrus of Goshen.

Committee on experiments and station work: Messrs. Edmund Hersey of Hingham, T. H. Goodspeed of Athol, N. I. Bowditch of Framingham, S. B. Taft of Uxbridge, Wm. H. Spooner of Boston.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Manchester, J. S. Appleton of Nantucket, E. A. Davis of West Tisbury, O. E. Bradway of Monson, H. A. Turner of Norwell.

Committee on institutes, rules and legislation: Messrs. F. W. Sargent of Amesbury, Edmund Hersey of Hingham, Edward M. Thurston of Swansea, W. B. Barton of Dalton, Henry C. Comins of Hadley.

Which appointments were approved by the Board.

Mr. Hersey, for the special committee on farmers' institutes, appointed at the last annual meeting, reported in writing, which report was accepted.

On motion of Mr. Sargent, it was

Voted, That, in the opinion of the Board, the time of holding the annual meetings of the several agricultural societies should be as near the same date as possible; and to this end this resolution be referred to the committee on agricultural societies, for their consideration and recommendations.

Mr. O. P. Allen presented and read an essay on "The evolution of agriculture," which was accepted, and will be found printed in this volume.

The committee on Agricultural College and education, by Mr. Bursley, chairman, reported recommending that the next public winter meeting be held at Worcester, on invitation of the Worcester agricultural and horticultural societies.

Voted, To accept the report, and that the next public winter meeting be held at Worcester, Dec. 4–6, 1900.

Voted, That the Chair appoint a local committee of five, to act with the secretary and the committee on Agricultural College and education, as a committee of arrangements. The Chair appointed Messrs. J. L. Ellsworth, J. G. Avery, W. A Kilbourn, C. A. Gleason and Isaac Damon.

The committee on Agricultural College and education, by Mr. Bursley, chairman, reported recommending the appointment of Oscar S. Thayer and Henry C. Comins to read essays at the next annual meeting of the Board, on subjects to be selected by the essayists.

Voted, To accept the report, and appoint the essayists as recommended by the committee.

The committee on agricultural societies, by Mr. Kilbourn, chairman, reported recommending that the date for the commencement of the fair of the Hoosac Valley Agricultural Society be changed to the first Tuesday after the first Monday in September; that of the Manufacturers' Agricultural Society to the second Tuesday after the first Monday in September; that of the Marshfield Agricultural and Horticultural Society to the third Wednesday after the first Monday in September; that of the Worcester East Agricultural Society to the second Wednesday after the first Monday in September; that of the Worcester North-west Agricultural and Mechanical Society to the second Tuesday after the first Monday in September.

Voted, To accept and adopt the report of the committee, and to change the dates as recommended.

Mr. Kilbourn, for the same committee, reported recommending the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 25, 26 and 27,	E. A. Davis.
Barnstable County, at Barnstable, August 28, 29 and 30,	Alvan Barrus.
Berkshire, at Pittsfield, September 11, 12 and 13,	H. C. Comins.

Blackstone Valley, at Uxbridge, September 11 and 12,	JOHN BURSLEY.
Bristol County, at Taunton, September 18, 19 and 20,	C. B. BENEDICT.
Deerfield Valley, at Charlemont, September 13 and 14,	Q. L. REED.
Eastern Hampden, at Palmer, September 18 and 19,	G. P. SMITH.
Essex, at Peabody, September 18, 19 and 20,	W. A. KILBOURN.
Franklin County, at Greenfield, September 19 and 20,	W. B. BARTON.
Hampshire, at Amherst, September 25 and 26,	H. H. SIGOURNEY.
Hampshire, Franklin and Hampden, at Northampton, October 3 and 4,	E. M. THURSTON.
Highland, at Middlefield, September 5 and 6,	C. A. GLEASON.
Hillside, at Cummington, September 25 and 26,	AUGUSTUS PRATT.
Hingham, at Hingham, September 25 and 26,	C. K. BREWSTER.
Hoosac Valley, at North Adams, September 4, 5 and 6,	J. S. APPLETON.
Housatonic, at Great Barrington, September 26 and 27,	O. S. THAYER.
Manufacturers' Agricultural, at North Attleborough, September, 11, 12 and 13,	O. E. BRADWAY.
Marshfield, at Marshfield, September 19, 20 and 21,	C. D. RICHARDSON.
Martha's Vineyard, at West Tisbury, September 18 and 19,	J. G. AVERY.
Massachusetts Horticultural, at Boston, October 2 and 3,	N. I. BOWDITCH.
Middlesex North, at Lowell, September 13, 14 and 15,	H. A. TURNER.
Middlesex South, at Framingham, September 18 and 19,	A. W. LLOYD.
Nantucket, at Nantucket, August 29 and 30,	J. L. ELLSWORTH.
Oxford, at Oxford, September 6 and 7,	F. W. SARGENT.
Plymouth County, at Bridgewater, September 12, 13 and 14,	J. M. DANFORTH.
Spencer, at Spencer, September 20 and 21,	ISAAC DAMON.
Union, at Blandford, September 12, 13 and 14,	G. P. CARPENTER.
Weymouth, at South Weymouth, September 27, 28 and 29,	JOSHUA CLARK.
Worcester, at Worcester, September 4, 5 and 6,	T. H. GOODSPEED.
Worcester East, at Clinton, September 12, 13 and 14,	F. H. APPLETON.
Worcester North-west, at Athol, September 11 and 12,	W. H. SPOONER.
Worcester South, at Sturbridge, September 13 and 14,	H. A. HOWARD.
Worcester County West, at Barre, September 27 and 28,	F. L. WHITMORE.

The report of the committee was accepted and adopted.

The secretary reported the delinquencies of certain societies in making required returns.

Voted, That the matter of delinquencies be referred to the executive committee, with power to excuse the societies if they present reasonable excuses.

Mr. Geo. P. Smith presented and read an essay on "Evolution of farm machinery," which was accepted, and will be found printed in this volume.

Voted, That the matter of asking the Legislature for an appropriation to continue abandoned farm work be recommended by the Board, and referred to the committee on institutes, rules and legislation.

Voted, That all unfinished business or new business arising before the next regular meeting of the Board be left with the executive committee, with power to act.

The records of the second day's meeting were read and approved.

Adjourned.

JAMES W. STOCKWELL,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Adopted at the Annual Meeting, Jan. 9, 1900.]

Conditions which influence agricultural societies from Berkshire to Nantucket vary widely. These societies, established in all the counties with the same general purpose, work under conditions which vary so much that criticisms which may be justly made upon one are unjust when applied to another. The law allows considerable freedom in the manner in which they shall carry out their duties, yet holding all to an expenditure of the money granted by the State for the certain definite purpose of improving the methods and stimulating the efforts of the communities around the different societies. We believe that the law is generally and commendably carried out, notwithstanding a considerable amount of outside criticism, a part of which is deserved.

The first condition for drawing bounty from the State to the amount of six hundred dollars is the holding of property invested to the amount of three thousand dollars. Your committee believe that this condition requires the holding of this amount over and above all indebtedness of the society; and then, when this amount is not so held, the bounty should be reduced; and when the sum falls below one thousand dollars, the bounty should cease, — and, in fact, the bounty has ceased and societies have lost their existence from this cause.

The second condition, holding institutes, seems to be fairly well carried out, though the institutes are not so popular or so well attended as they should be. Subjects are well chosen and addresses are given by able men; but one or two hundred will cover the attendance in most instances, and in many cases the attendance is much smaller. We commend more effort to secure a fuller attendance upon these meetings.

The inspectors of the several fairs report, with only one exception, fairs well conducted, attractive and instructive,

and, with some criticism on sanitary arrangements in some cases, but few objectionable features are mentioned. While many societies have found some outside attractions desirable, most if not all have commendably carried out the purposes of the law in holding their exhibitions and awarding their premiums.

We hold that in all cases the amount of the bounty received is to be awarded to purposes strictly agricultural, or including, besides these, only horticultural exhibits and domestic manufactures, such as are covered by the reports annually required. With few exceptions, the premiums awarded to these departments have been in excess of the requirements of the law.

We again caution all societies of the dangers of incurring large expenses, and the risk of impairing their invested funds.

W. A. KILBOURN,

Chairman.

REPORT OF COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

[Adopted at the Annual Meeting, Jan. 9, 1900.]

The Massachusetts State Board of Agriculture has ever been a power in its influence for the better care and the kinder treatment of all our domestic animals. In the appointment of the committees of this Board, this work was given special place because of its importance. This Board, through its institutes and lectures, has brought the farmers of the State to realize that the sympathy which should exist between the animal and the one who has the care of it has a money value in increasing its work or its product. This is more particularly noticed in the dairy herd, but extends to each and all the animals in our charge.

The need and value of sanitation for the health and best returns from our stock has been very fully demonstrated, and the Cattle Commission is now charged by the law of the State with investigations in this important feature of dairy work. Your committee give their approval and aid to this work, and realize that the position of the Board of Agriculture is strongly in favor of kindness, good care and cleanliness in every department of farm stock.

ISAAC DAMON.
JOSHUA CLARK.
OSCAR S. THAYER.
F. L. WHITMORE.
A. W. LLOYD.
H. A. HOWARD.

Report to the Legislature of the State Board of Agriculture, acting as Overseers of the Massachusetts Agricultural College.

[P. S., Chap. 20, Sect. 5, adopted by the Board, Jan. 9, 1900.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

Your committee have completed the duties assigned to them. The members have visited the college frequently, attended the commencement exercises, and awarded the Grinnell prizes in agriculture.

The Grinnell Prizes.

The Grinnell prizes were awarded as follows: first prize, to Bernard H. Smith of Middlefield; second prize, to Samuel Smith of Middlefield, — both prizes going to students from one of the hill towns of the western part of the Commonwealth. The awarding of these prizes is one of the most difficult duties of the committee. The contestants, four in number, showed excellent knowledge of the topics assigned to them; their essays were well written, and the oral examination showed their understanding of principles and also their familiarity with the subjects before them.

The Farm.

The usual farm crops were grown this season, and the yields were in keeping with the care and culture given to them, the hay crop showing the result of careful and systematic manuring, the drought not showing as bad effects as where the soil had not been so carefully cared for.

There seems to be no special criticism to apply to the horses, sheep, swine and poultry of the farm. There is as yet considerable conflict of opinion as to the cattle, but, as fair discussion is the education of the people, this is well. Among the more than one hundred cows and heifers there appear to be some excellent milking stock, some well calculated for beef, some not easily defined as belonging to either class, and others still giving good evidence of the all-purpose cow. In these days of keen competition, are these the cattle to hold up to Massachusetts dairymen as models to breed toward? There are several good specimen bulls in the barns, but not a steer or working ox on the premises, the raising and driving of which is fast becoming a lost art, not only here but also on nine-tenths of the farms of New England. Our people are quite as particular concerning their beef supply as their milk supply, and, with the stock of cattle falling off one-third in two years, a beef famine in the Old World, and our mountain pastures not one-third stocked and many of them not stocked at all, we are led to ask, Whither are we tending? Would it not be profitable to Massachusetts agriculture if the energies and acres of the college farm were devoted to showing our farmers typical herds for milk, butter and beef?

The Hatch Experiment Station.

New buildings, trucks, railway, etc., for carrying on the pot experiments have been added this season. Many of these same experiments are carried on upon a larger scale in the field, and the results of both tests carefully compared. By these tests information relative to providing well-balanced food rations for our plants is gained.

In the horticultural department tests of seeds and fruits are carried on, different fertilizing material tried and various forms of spraying practised.

The entomological department is constantly experimenting to find economic methods of destroying the various forms of insect life destructive to the crops of the farm and garden. In this connection it may not be out of place to state that arrangements have been made to allow those in charge to go about the Commonwealth, to better study the habits and depredations of insects in their homes.

We would urge all farmers to avail themselves of the information published in the experiment station bulletins, which are free to all who desire them.

The Zoölogical Department.

It is the purpose to make the department of zoölogy in this college first class in every sense. Insects are of vastly greater importance to the farmer than all other organisms put together. It is for this reason that special attention has been given to the development and equipment of the division of entomology, and we feel that in this respect this institution is fully equal to any other in the country. The purpose is to educate the young men who elect the study of entomology so that they may not only fully understand the principles of economic entomology, but that they may be able, should an unknown insect appear, to investigate the new pest in a thoroughly practical and scientific manner, and discover the means of dealing with it. Realizing that a first-class farmer needs this education, they are striving to cultivate a spirit of investigation in all the students taking this course of study.

The Veterinary Department.

The buildings have been completed at an expense of about $24,700 of the $25,000 appropriated, about $300 being left after paying for construction. This amount has been used for the purchase of equipment. Early in the fall an order was placed for sufficient apparatus to equip the laboratory building to the extent of rendering it available for purposes of instruction. To put it into condition for experiment work a few pieces of special apparatus are required. The aim of the work in this department is threefold: first, education of the students; second, experimental research, the investigation of obscure diseases, etc.; third, to render assistance to all farmers by the examination of the organs of diseased animals, or by correspondence relative to disease amongst live stock. They are always glad to have specimens sent in for examination, and in case of an outbreak of an obscure disease among animals the department stands ready to investigate the cause, nature and danger from the same, in so far as it is able to do so.

When both laboratory and hospital stable are fully equipped, they will contain every facility for the study of animal diseases. The facilities for work in bacteriology and pathology will then be exceptionally good. This main building and the hospital barn place this important branch of learning on a footing equal or superior to that of any other department at the college. This should be welcome to owners of live stock and to students who intend to follow agriculture or to become veterinarians. We would suggest that all who can, call and see for themselves. In the main building there is an office, lecture room, dissecting room, a large laboratory with tables for students to work with the microscope, two rooms that may be used as living rooms by students, a room for advanced students in which to do experiment work, and also a carpenter's workshop. In the barn are stalls where different animals can be kept and isolated in case of danger of infection. These stalls are so arranged as to be easily cleansed and disinfected. The building is heated and ventilated in the most approved manner, and supplied with hot and cold water at all seasons of the year.

At the time of your committee's visit the doctor had under his care some diseased chickens. Experiments were in process to learn the nature of the disease known as roup, by an attempt to develop culture. This is simply an indication of what may be done in the future in all lines of germ or other diseases of farm animals.

The Horticultural Department.

The work in this department has been carried on in the usual efficient manner. Testing of numerous varieties of strawberries, raspberries and other small fruits is continually going on. The instruction here in propagating by grafting, budding, etc., is given in a practical way, the student doing the work, the hand thus being trained as well as the mind. The manner of combating the many insects injurious to our fruits and flowers is illustrated by the practical way in which these foes of the farmer are met.

The old peach orchard has finished its work and been removed, but a large new orchard has been planted on the

highest ground of the Clark property, which is in a very thrifty and growing condition. The old and well-established vineyard produced a large crop of fine fruit of excellent quality. In the small vineyard and near the plant house experiments in spraying and girdling have been carried on.

The Class Room.

There have been no changes in the arrangement of the course for candidates for the degree of B.S., the students being required for the first three years to follow one regular course of study. In the senior year several elective courses are laid out, with co-related branches grouped. Students are allowed to elect which courses to pursue, but all are required to take English and military.

The method of giving instruction is largely by lectures, illustrated by charts, models and specimens of objects under consideration. The idea that governs the professor in the class room is that practical application of truths, whether in agriculture, industry or the arts, is equally important with absolute knowledge. Well-equipped and commodious laboratories are provided for the students in each branch of the sciences, to work out the ideas for themselves.

A few students have taken the short winter course, mostly in the dairy school, where a great variety of machinery is in operation. Butter made under different methods of cream ripening was scored by experts and the results published. This work should be of interest to dairymen and butter makers. Prizes were given to students for the best work, and this course of study is of special value to Massachusetts agriculture, as a large proportion of our farmers are engaged in the production of milk and its products, and the opportunity offered by this short winter course, at a time when perhaps the boys can best be spared and when many older men can come here and spend a few weeks, may be of great advantage. The studies are not confined simply to milk and its care, but also include the care of the dairy and the production of food products associated with it.

Military Instruction.

Since the outbreak of the Spanish war the college has been without a military instructor. This we feel to be a great disadvantage, and we trust that soon there will be an army officer assigned to the college, so that the students may receive the same military training as heretofore. The strict discipline and order enforced will be of decided benefit to many of them in after life.

Advantages and Needs.

As your committee have year after year visited this college, we are more and more forcibly impressed with the great value of this institution; and the question is constantly presenting itself, What can be done to show the advantages of the Massachusetts Agricultural College as a place to educate the boys and girls of the Old Bay State? How can they be induced to become interested in the college, — for we feel that, as surely as they are, the agricultural college will not lack for students. Is it advisable to place a paid lecturer in the field, as is being done for other institutions? Or perhaps a person to visit the high schools of the State, and present to the pupils themselves the opportunities offered by our college? Would it be desirable that each society receiving bounty from the State should have for its topic at one of its institutes the coming year the subject of the college and its advantages? Would this bring it to the attention of the class whom we desire to reach?

Your committee feel that there is need of further endowments or permanent funds. Of course as the alumni of the college grow older there will be less lack of these than at the present time. We call the attention of the Board to this fact, feeling that perhaps some of us might be enabled to call the attention of some person to this college who would see the necessity and come to the aid of a worthy cause.

In closing, we desire to call the attention of the Board to the fact that nearly one-half a century of its work is completed; and, knowing and realizing that great good has been accomplished by the Massachusetts Board of Agriculture, we

believe that this anniversary is worthy of more than passing attention, and that the memory of these distinguished workers in the cause of agriculture should be recalled, and the work of the Massachusetts State Board of Agriculture be remembered as its best encomium. Suitable preparations should be made for the proper observance of this occasion in 1902.

JOHN BURSLEY.
C. K. BREWSTER.
GEO. P. SMITH.
ALVAN BARRUS.
WESLEY B. BARTON.

REPORT OF COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Adopted at the Annual Meeting, Jan. 9, 1900.]

The duties of this committee are defined in article 11 of chapter III. of the by-laws of the Board; and your committee are there charged with the duties of the Board of Forestry, under chapter 255 of the Acts of 1882, with all matters relating to forest fires (the greatest curse to forestry), the promotion of forests and the reforestation and reservation of public lands for the culture of forest trees. Also all matters relating to roads and roadside improvements, shall be referred to this committee, who shall consider the same from time to time and report to this Board. Said chapter 255 is composed of five sections. Section 1 is upon the preservation and culture of forest trees by cities and towns, and gives them the right to appropriate money to take and purchase land, to receive donations of money or land for the purpose, and to make public domains of such land. The right to make rules and regulations to control it is included in this section. Section 2 requires early descriptions of the land taken to be recorded in the registry of deeds. Section 3 states that the Board of Agriculture shall act as a Board of Forestry, to serve without pay, and shall appoint keepers. Section 4 provides for sale of products to be paid to the Board and applied to the management. Section 5 gives power to erect buildings for instruction and recreation. But other plans have been advanced and other acts have been passed and associations have been formed, which have taken the place substantially, if not wholly, of the act which I have quoted from our by-laws.

Your committee have not been unmindful of the charge placed upon them, and, while the members have severally, I

am sure, done what they have been able to do to advance the interests of the State in such lines, by their chairman they have been represented before committees of the last Legislature to promote activity and thought on such lines; and he has been cognizant of the workings of the Massachusetts Forestry Association, the committee of the Massachusetts Horticultural Society, and with the efforts of the many park boards with inclinations to improve tree culture rather than the forest territory. But a better knowledge of pure forestry is coming about, although, until lumber and pulp shall become scarce, such forestry will be little attempted except as "fancy forestry."

The metropolitan parks about the city of Boston afford fields for a nearer approach to pure forestry than most other public lands with which I am familiar. Before the real need for pure forestry comes, let us do all we can to implant, in the minds of our people who are able to carry on its operations, a knowledge of how forestry is conducted. If what is called "fancy forestry," or, as I understand it, pure forestry, conducted for healthful occupation, can be a forerunner of that time of need, let us encourage all attempts at such forestry, and strive to urge the right people to study such work and become familiar with its principles.

Some of those details can be read of in a little "beginner" by Des Cars, but that beginner has much depth to it. I mention it because it can be easily read, and its story is plainly told.

The penalties for forest destruction by fire must also be more positive than is yet the case before forestry can become an industry. In older countries, ownership in forest land is reported to be as safe an investment as government bonds; and, if so, it is because the government protection is as good for one as for the other.

I feel that we shall all appreciate, among other things, the wise advice of Governor Crane in his inaugural as to the highway planning for the State, — that a comprehensive plan be formulated, and worked up to by all whose responsibilities tend that way.

Without appropriations your committee can accomplish little, and, while others are working out our problems with

corps of workers, we can feel satisfied that good is being done on our lines, even if under other acts than are entrusted to us.

Dr. C. A. Schenck, forester to the Biltmore estate, Biltmore, N. C., and principal of the Biltmore School of Forestry, mentions the following drawbacks to forestry as an investment in the United States, and they seem to be well worth including in this report: —

1. It is more difficult to dispose of forest realties, if the owner is compelled or desirous to sell, than of any other property. Conservative forestry is a clumsy investment, and does not allow of gains by quick-minded speculation.

2. It is not easy for the owner to watch the faithfulness of those in charge of his forestry interests, which necessarily extend over a large area.

3. There are no foresters available in America to have charge of the work in the forests.

4. An annual revenue cannot be derived, unless forestry has been practised on a large scale for a long time.

5 It is difficult to separate "net revenue" from "capital withdrawn from the forest," unless stock is taken frequently and carefully. Stock taking in the forest is very expensive.

6. Forestry requires steady management, and yields returns on the same spot only in long intervals, — intervals often longer than human life; in other words, forestry requires a long-lived owner. In the old country this drawback does not weigh heavily, as towns, villages and families holding the property entailed are the chief owners of well-managed forests (aside from State forests), and as the population is not so shifting as in the United States.

FRANCIS H. APPLETON,

Chairman.

REPORT OF THE COMMITTEE ON FARMERS' INSTITUTES.

[Adopted at the Annual Meeting, Jan. 10, 1900.]

In considering what, if any, improvement can be made in institute work, your committee recognize the fact that the farmers' institutes, as conducted in the past, have been of great benefit to the farmers in every county in the State, and believe they should be continued until something better is found to take their place; therefore our efforts for improvement are in the direction of introducing such additional work as will eventually lift the farmers up to a position which will enable them to do better and more thorough work in the future than they ever have in the past.

Since the farmers' institutes were inaugurated a great change has taken place in the methods of producing farm crops; and the farmer is becoming more fully convinced that, to be a successful farmer, his labor in the future must be directed by higher intelligence than has been necessary in the past. The time has come when the successful farmer needs to have some knowledge of how plants grow, and how best to feed them with materials that can be used with the largest profit; and he also needs to know more about the care of farm animals, how to feed them in the best manner at the least cost. While a single lecture on either of these subjects may help the farmer to do better work, it is not sufficient to cover all of the important points and make them fully understood by the farmer who has not made himself familiar with the underlying principles of plant and animal growth. Your committee are of the opinion that to fully cover either of these two subjects, and many others that could be named, would require three lectures from one who has a thoroughly practical knowledge of his subject.

We therefore recommend that whenever any farmers' organization in the State shall desire to have a course of not more than three lectures on any farm subject, they may apply to the secretary of the Board of Agriculture for a lecturer, and the secretary, if he thinks the subject a proper one, shall furnish a lecturer, providing he can secure a competent person to attend on the dates named, and also providing that he has not already been called on during the year to provide lectures for more than thirteen courses. The lecturers shall be paid out of the money appropriated for lectures.

And we further recommend that the Board inaugurate the system of holding one summer institute meeting each year, at such time and place as shall be decided upon by the Board; and that the secretary shall provide subjects and speakers for the occasion.

EDMUND HERSEY.
F. W. SARGENT.
C. D. RICHARDSON.
CHARLES A. GLEASON.
J. W. STOCKWELL.

REPORT OF THE LIBRARIAN.

[Adopted at the Annual Meeting, Jan. 9, 1900.]

To the Secretary of the State Board of Agriculture.

SIR: — The third report of the librarian is herewith presented. The past year has witnessed the completion and publication of the catalogue of the library authorized by the Board at its last annual meeting. Five hundred copies were printed, of which one hundred copies have been bound and distributed. It is suggested that provision be made for binding and distributing the remaining copies. It is believed that the catalogue will do good and will be found useful in a variety of ways and by various classes of people. The head of the agricultural department of a neighboring State, acknowledging the receipt of a copy, wrote: "It is a valuable publication, and I hope to make use of it in arranging the library which I am endeavoring to start in this State. There has been no effort made here to provide an agricultural library, although the department has been in existence for many years."

Library work for agriculture is to be discussed in an article in the Year Book of the United States Department of Agriculture for 1899, and it has been the privilege and pleasure of this office to assist in supplying material for this article.

The "Agriculture of Massachusetts" still continues to make friends, and as agricultural knowledge is spread abroad by means of and through agricultural organizations and interests of various kinds and character, these volumes are more and more appreciated by progressive agriculturists. On the one subject of "dairying" the late secretary of this Board has recently and truly said: "In the annual volumes 'Agriculture of Massachusetts' for the last twelve years may

be found a library of instruction on dairying that will repay the careful study of every man who keeps a cow." The demand for back volumes to fill sets continues. Among the recipients the past year have been the St. Louis Public Library, the New Haven Free Library, the Pennsylvania Department of Agriculture, the University of California and the Belgian Department of the Interior and of Public Instruction.

The expenses incurred on account of the library the past year were as follows: printing catalogue, $199.79; books and pamphlets purchased, $73.21; current publications subscribed for, $28.82; binding, $20.15; supplies, $13.72; total, $335.69. These expenses were paid from the appropriation for "incidental expenses in the office of the secretary."

The number of bound volumes in the library Jan. 1, 1900, was 3,215.

It is suggested that the following regulation governing the loaning of books from the library be adopted: "Books borrowed from the library of the Board must be receipted for and returned within one month."

Respectfully submitted,

F. H. FOWLER,
Librarian.

THE EVOLUTION OF AGRICULTURE.

BY O. P. ALLEN, PALMER, MASS.

All things connected with human energy have had a beginning and a period of development. Some things surprise us by the magnitude of their early fruition, and often amaze us by their premature decadence and splendid ruins. Painting, sculpture and architecture reached the acme of perfection ages ago in Grecian thought and activity, because those arts fell under the fostering care of a people every way fitted for perfecting them, leaving all future peoples unable to surpass their grace and divine beauty.

Agriculture had the earliest genesis of all human effort, and has occupied a longer period for the developing of its usefulness than any other industry which has claimed man's attention, and it still lingers far behind the goal of perfection.

It was stamped with the insignia of Heaven's approval at the very dawn of man's existence; for, when he was sent forth from the felicity of Eden into the world's broader domain, he was commanded to subdue it and hold lordship over all its unlimited possibilities.

The men of pre-historic times seem to have been divided in their pursuits; some developed a taste for domesticating the animals suited for their needs, and became absorbed in their care and increase, to the exclusion of other occupations, which propensity survives among many nomadic tribes of the present day; while others combined the tilling of the soil and the care of flocks and herds, thus laying the foundation of the grandest industry that has ever blessed the world.

The early man had everything to learn, and it is no wonder he made slow progress in constructing utensils connected with his labor and in selecting suitable grain-bearing herbs adapted to his wants; but, once selected and proven, he made better progress than we might suppose in dissemi-

nating them wherever he went, and handing them down to us as evidence of his wisdom. We sometimes express wonder because agriculture has been so devious and irregular in its course; we must bear in mind that it has followed the fortunes of nations, rising in their prosperity and declining in their decay. Hindered often by the devastations of war and the disorganization of communities, it has risen phœnix-like from the ashes of its funeral pyre, to begin over again its work of necessity.

Agriculture was held in the highest estimation by the early peoples, among whom a divine patron was always allotted to preside over its affairs, whose favor was constantly appealed to by offerings and oblations.

Agriculture is supposed to have had its early home in the valley of the Euphrates, where it was fostered with the greatest care; the great river was made tributary to its needs, being conducted into a system of canals for the purpose of irrigating the adjacent plains, which became very gardens of luxuriance, where wheat yielded a hundredfold, and other products were cultivated in abundance for maintaining the great city of Babylon. Thus early did mankind begin to utilize the resources of nature for the benefit of farming.

Egypt was the next early home of agriculture, where father Nile took kindly care of his devoted valley, annually enriching the fields with his overflowing flood. There the early kings were patrons of husbandry, and provided spacious reservoirs to conserve the river's overflow for future use in needed irrigation. In process of time this country became the granary of Rome in her imperial days, and now, after thousands of years, is as productive as when Abraham went there to succor his family because of famine in his own land.

The early kings of Assyria and Persia took a paternal interest in agriculture, not only because it contributed to their own income, but because its prosperity added to the happiness and contentment of their subjects. To this end the governors of the provinces were rewarded or punished according as their provinces were successful or neglectful in their agricultural management.

In China, that land of unique customs, agriculture has always been held in high repute from the most ancient period.

From time immemorial they have ushered in the agricultural year by a festival in which the emperor performs the operation of ploughing and sowing seed, and thus honors and stimulates the husbandman in the pursuit of his calling. Thus singularly honored, the farmer in China holds a rank higher than the soldier or merchant.

In India the great mass of the people have from the earliest times been devoted to husbandry. Palestine, as we well know, was for ages one of the most luxuriant of agricultural countries; by divine appointment its lands were divided into small holdings, which could not be permanently alienated from the line of its original possessors. It was so well cultivated that it supplied a dense population, so that in the time of Christ, according to Josephus, there were three millions of people in Galilee alone. There, too, as in most oriental countries, irrigation had much to do with the productiveness of the soil. Its present desolation is due rather to the lack of a paternal government than to the natural fault of the soil, which is still as capable as of yore of supporting a large population.

The kings of ancient Rome fully realized the importance of agriculture. They took a personal interest in the affairs of the husbandmen, inquired into their success on the farm and their methods. They praised or admonished, as the case seemed to require, thus stimulating them to put forth their utmost efforts in the application of manures to produce the greatest quantity of crops. Numa, one of those early kings, is said to have exacted a minute account from the husbandman, how he carried on his farming; and when we consider that the primal wealth of a nation comes from the cultivation of the soil, the early rulers of the ancient nations gave evidence of great wisdom in thus exerting their influence in encouraging the agriculturist to carefully plan and prosecute his work.

The great men among the ancient Romans delighted in husbandry, and toiled along with their servants on their farms. Cincinnatus went from the plough to serve and save his country; many senators and generals who had been honored by triumphs lived in the country and labored on their farms, though blessed with fortunes. Cato, the censor, often

returned from pleading the cases of his clients to till his beloved acres. But these were in the days before Rome became depraved. Pliny says: "In those happy times, the earth, glorious in seeing herself cultivated by the hands of triumphant victors, seemed to make new efforts to produce her fruits with greater abundance; that is, no doubt, because those great men, equally capable of handling the plough and their arms, of sowing and conquering lands, applied themselves with more attention to their labor, and were of course more successful in it. And, indeed, when a person of condition, with a superior genius, applies himself to arts, experience shows us, that he does it with greater ability, force of mind, industry, taste and with more inventions, new discoveries and various experiments; whereas an ordinary man confines himself within the common road and to his ancient customs; nothing opens his eyes, nothing raises him above the old habitudes, and after many years of labor he continues still the same, without making any progress in the profession he follows."

It is also interesting to note the fact that numerous great men of ancient times not only wrought on the farm, but they gave the world the benefit of their experience in voluminous treatises on agriculture. It is surprising that Mago, the great Carthaginian general, wrote twenty-eight volumes on agriculture, which were deemed of such importance that they were translated into Greek and Latin. There were fifty Greek authors who wrote upon agricultural subjects, according to Varro. Among the Latin authors, the most noted were Cato, Varro and Columella, who treat with much detail the various departments of agriculture.

The foregoing account covers the palmy days of the republic, when the proudest claim a man could make was that he was a Roman citizen. Then followed the empire which became burdened with the evils of luxury, effeminacy and vice, when all that was noblest under stern republican rule faded from the minds of men, who scorned to be known as farmers, who relegated such menial service to slaves; and, as a result, husbandry declined, while Rome hastened to its final disruption by the barbarian hordes, and into the gloom of the mediæval night, which blasted Europe with its miasma

of feudalism for a thousand years, when wars and crusades and superstition flourished, and arts and science and letters, religion and husbandry languished. The turmoil of ten centuries went on, till out of the crucible of fierce unrest Europe came, disenthralled at last, in the awakening of the sixteenth century. Then husbandry as well as all other laudable callings began to feel the invigorating influence of the new era, and, as the new forces came into line, governments and people came more and more to feel they existed for each other. Since then governments have been learning some useful lessons from painful experience, and have found paternalism to be a paying factor. There is France, for instance, which has exchanged nine-tenths of her population, which were held in practical slavery during a long period of the feudal ages, for the contented and prosperous peasantry of to-day, who constitute more than half of her population, and are directly supported by the various pursuits of agriculture. The government directly looks after their best interests, and endeavors to encourage their advancement by every worthy means. What a contrast, when section preyed upon section, and all existed in abject terror of the over-lord!

Germany, grown powerful by unifying her interests, has also learned wisdom from the past, and is devoting much attention to the advancement of her increasing agricultural affairs. Her scientific men are patiently delving into the mysteries of the vegetable kingdom, and are constantly solving problems which will be of the greatest value to the farmers of the world.

Little Holland has shown us how to tame old ocean and wrest grand trophies from his grasp, and transform bogs and fens and sea-washed inlets into smiling fields and gardens of wealth and beauty.

And England is not forgetful of her toiling sons, who subsist upon the productions of the soil; there the fawning retainer of feudal days has been replaced by the prosperous and contented tenant of to-day, whose well-tilled acres bring him comfort and plenty.

Our own country, the youngest of the nations, has made rapid strides in all departments of agriculture; our methods

of farming are being improved, thanks to the knowledge furnished by the experiment stations in nearly every State of the Union; and our agricultural colleges are proving large factors in raising agriculture to the dignified position where of right it belongs, and rendering popular and practical the knowledge which should go with such an important, world-wide industry. Much is also due our central government for its increasing interest in agriculture and for its dissemination of knowledge among the people.

To-day our nation stands in the front rank of the great food-producing countries of the world. When shortage of crops occurs in other lands they look to us for a supply, which we are always ready to meet for their benefit and our enrichment.

But, with all our wealth of land, our farmers are not quite contented, which fact no doubt arises from the reason that wealth on the farm is not produced as rapidly as in mercantile or commercial pursuits; and yet we hear of far less failures among the farming community than among those of any other calling. This fact alone ought to reconcile the farmer to his slower but surer method of acquiring wealth.

The evolution of agriculture in the oriental world has been slow, where the antiquated methods of the ages still prevail, but for the western world nothing but progress will satisfy the requirements of the present or the future. Science, ever alert to meet the demands of changed conditions, has come to the farmer's aid as never before, and will continue to be a mighty factor in the future methods of farming. This fact moves us to remark that before the next century has far advanced every farmer worthy of the name will come to know the composition of his own soil in every detail and its adaptability for producing crops. He will see the wisdom of carefully studying the best method of producing home-made fertilizers, and their proper application. He will be alert and meet the first approach of new pests, and be ready to destroy them before they are allowed to gain a foothold; he will study the nature and causes of crop blights, and be ready to apply the needed remedy; he will also learn the wisdom of protecting insect-destroying birds, and encourage their increase in every practical way. In the coming future there

will of necessity be a great increase of farms with smaller acreage, to the great advantage of the farmer, who, with his increased knowledge and the adaptation of means to a desired end, will be able to produce more on fifty acres than his ancestor obtained on double that amount of land, which will mean for him less labor and more profit.

The twentieth century has mighty possibilities in store, whose achievements will astonish the world, but not the least will be the progress in agriculture; the most approved systems now in vogue will then become obsolete, and the world will awake to the knowledge that successful farming will require more intelligence and skill than was ever dreamed of in the past.

The needs of increasing population, the stimulus of keen competition will serve to accelerate progress along all lines of agriculture in the coming years. Then there will be little or no waste lands. Our abandoned farms will be reclaimed; some will be devoted to sheep husbandry, some to the growth of forests, and others brought back to tillage, as their merits deserve. Let there be no pessimists among the young farmers, but let them all buckle on the armor of diligence, prepare their minds by well-directed study and observation, and be ready to reap the fruit of intelligent labor. The promises for the coming years are greater than the past has ever held out; for, as has been remarked, science will solve problems which will reveal a new world for the farmer to revel in, if he will accept the boon and profit by it.

The time will also come, if the farmer is true to himself, when he will occupy the enviable position in the State, — enviable because of his independent position, because of his intelligence and being able to dictate terms to the politician; for then he may, if he will, be the determining factor in the State, capable of wielding his power for the best good of the body politic.

This optimistic view is based on the thought that the coming farmers will conserve and unify their power for self-preservation, and as a bulwark for the State; and in this may not the future historian record the crowning glory in the closing cycle of agricultural evolution?

But, after all, the great story of agriculture has never yet been written, and the world is waiting for it; it is due the myriads of farm-born men to have their story told by one imbued with a lofty love for the theme. When written, it will be found to be a story of the ages; a story of heroism, a story that will surpass in interest and importance the victories of the plumed knights of the ages of chivalry; for it will recount man's triumphs over nature, over heat and cold, over storm and blast, over arid wastes and dismal fens, over river floods and ocean encroachment. It will contain the secret inspiration of the poet's dream, the essence of man's richest thought, the scientist's deepest research, the secret of supplying the world's mighty armies, the source for the relief of famine-stricken lands and of the daily supplying of great cities with food. It will reveal the secret how States were founded and nations sustained. Why commerce has flourished and merchants have grown rich. In fine, it will furnish the grand background of all history with details too long ignored by the superficial student. It will remove the veil which too long has hidden from view the great mass of the world's middle class of toilers, and tell us how they have prospered when they could and suffered when they must; how they have thought and planned and made progress as they could, and forever delved that the world might live.

In the evolution of the future such a work will needs be written, in order to supply the demand for a deeper study into the hidden forces of the past; then the eyes of the urban resident will be opened as never before to the importance of an industry which, perchance, he has affected to despise because he had failed to comprehend it. Then, too, the world will learn to appreciate the farmer and applaud his success, carried to fruition by continued patience and fortified by the demonstrations of science.

THE EVOLUTION OF FARM MACHINES, WITH SOME SUGGESTIONS AS TO THEIR USE.

BY GEO. P. SMITH OF SUNDERLAND.

This paper will not attempt to discuss primitive forms of the plow and other implements of husbandry, but will begin by inquiring into what means the American farmer had at the beginning of the nineteenth century of preparing the soil for his crop and for cultivating and harvesting it.

He had a kind of plow, made mostly of wood, perhaps with the natural twist found in the trunk of some tree for a mold-board. The local wheelwright was called upon to help him out with the wood-work, and the blacksmith furnished a steel point and more or less armor plate for the land side and mold-board. The earliest form of the plow used in the prairie soils of the west was made of old saw blades. The farmer also had a harrow, probably a V-shaped frame with straight teeth; a cultivator of wood frame, of about the same shape, with teeth something like a duck's foot. For harvesting there was the scythe, sickle, hand rake, and possibly a large rake, sometimes called a bull rake, for gathering after the cart.

The Plow.

The plow might be considered on slight thought to be a very simple implement, but on further consideration it will be seen to be quite complicated. Extremely elaborate calculations have been employed by inventors to determine the correct form of the mold-board, which may be considered as two wedges at nearly right angles to each other, joined by a curved surface. The problem has engaged the minds of some of the most able men known in American history, — such men as Thomas Jefferson, Daniel Webster and Frederick Holbrook.

Evolution means unfolding. We may consider, then, that modern farm machinery has been unfolded from the minds of the inventors, and we shall often find, as in the case of the development of living organisms, that the old is often retained in a modified form with something added.

Previous to the beginning of the nineteenth century the improvement of the plow had begun in England, probably on lines taken from a plow introduced from Holland. The first patent was obtained by Joseph Foljambe in 1730. Jethro Tull may be considered the father of modern farm machinery. His inventions included a plow, drill, cultivator and threshing machine. This plow, known as the Berkshire plow, was attached to high wheels and gallows by means of beam and chain. It was provided with four coulters to thoroughly pulverize the soil. In 1730 Tull's work, "Horse-hoeing husbandry," was published, in which it was claimed that with thorough tillage no manure was needed. For this extreme position he might be called a crank; but recent experiments have proved that considerable increase in the crop may be obtained by more thorough work, for the reason that cultivation liberates plant food in the soil and prevents too rapid evaporation of moisture, — a condition so essential to plant growth. We must admit that it is unwise to expend a large sum for fertilizers unless careful attention is given to preparation of the soil. In this particular we often fail for want of time and perhaps for lack of the best implements. The farmer of to-day must know something of science as applied to his business, and he needs to know something of machines, — at least enough to adjust his machinery so as to get the best results, and at times make slight repairs.

In 1763 James Small, in England, invented a bridle and clevis, to adjust the point of draft to the beam, similar to the ones in use at the present day. This inventor claimed that he had rules for projecting the lines of the mold-board to the plow so as to place the furrow in any position desired. In writing upon the subject in 1802 he says: "If all farmers were agreed as to the place and position in which the earth must be left, all plows would be made alike. The mold-board should have equal degrees of rise and twist for each inch the plow advances."

Thomas Jefferson, in 1793, was the first one in this country to use a cast-iron mold-board. He advocated the doctrine that the mold-board should have straight lines at right angles. His plow did not have sufficient twist to turn the furrow properly. It may be said that since Jefferson American inventors of the plow have embodied Tull's idea, — that pulverizing the soil is the main thing to be sought in plowing. The British seem to regard a smooth furrow with uniform crest across the field as more essential, consequently they use more straight lines in the mold-board.

Robert Ransome in England, in 1803, and Edwin A. Stevens in America, in 1817, independent of each other, invented a process of chilling or case-hardening the bottom of the share, as a means of keeping the cutting edge sharp when the plow becomes worn away. The first letters patent on a cast-iron plow in this country were granted to Charles Newbold, a farmer of Burlington, N. J., in 1797. This plow had sheath, land side, mold-board and share cast in one piece. Mr. Newbold spent a large sum of money in trying to introduce his improved method of plowing, but it did not meet the approval of farmers to any great extent. It was looked upon with suspicion by many, who said the iron poisoned the land and caused weeds to grow.

As late as 1820 a writer in the "Rhode Island American" says that "in most parts of Massachusetts, the Old Colony plows, with ten-foot beam and four-foot land side, were still in use; and the Sutton plows, 'which are not fit to plow any land that has sod on it; your furrows stand up like the ribs of a lean horse in the month of March. A lazy plowman may sit on the beam and count every bout in his day's work.'" One famous Old Colony plow was the one made by Daniel Webster, and used by him in breaking up sod and new land on his farm in Marshfield.

In 1819 Jethro Wood of Scipio, N. Y., obtained a patent on a plow made of iron, with the different parts cast separate. This ushers in a new era in the history of the plow, — the era of manufacturing as distinguished from the era of building in small quantities by blacksmiths or plowrights, by making it possible for the farmer to replace a broken or worn-out casting with a new one from the factory. By the

law of the survival of the fittest, this invention prevailed and gradually replaced the old wooden plows. Mr. Joel Nourse, in 1842, improved upon the plow and brought out his famous Eagle plows, that became very popular and reached a sale of twenty-five to thirty thousand in one year. He made his mold-board larger, with more abrupt curve in the rear part, thoroughly inverting and breaking up the furrow.

Hon. Frederick Holbrook, afterwards war governor of Vermont and professor of agriculture at Cornell University, invented improvements on the plow during the period from 1850 to 1860. He constructed plows with different mold-boards for different conditions of soil, brought out the sod and subsoil and swivel plow. The sod and subsoil plow of Holbrook's, as in the Michigan plow of Aaron Smith, was a small plow with a fin share in front of the main plow, and was designed to accomplish what is now better and more easily done by the jointer, introduced by James Oliver of South Bend, Ind., who, after many years of experiment, perfected a process of chilling and toughening iron to make it suitable for the mold-board. This invention, and that by John Lane of Chicago of what is known as soft-centre steel, has revolutionized plow making, and almost wholly driven cast iron out of the field.

Swivel Plows.

The first plow to turn all furrows one way was called the turn and rest plow. It was nothing more than a simple wedge, made to turn on a pivot and governed by an arc in the back part, passing through a slot in the handles for changing. In this form each side became alternately land side and mold-board. The form invented by Governor Holbrook, with one mold-board, and sole and land side alternating, and, as modified and improved by later inventors, is the prevailing form now in use, and is so well liked that its use in preference to the right-hand plow is increasing.

Line of Draft.

It is evident that the plow in passing through the soil encounters resistance from three directions, — from the bottom of the furrow, from the land side and from the furrow slice.

Experiments have shown that it requires about ninety per cent of power to move the weight of the plow and to cut the furrow, and only about ten per cent to turn it over. If we consider that there must be a centre of resistance, it would be found near the land side and not far from the sole. To prevent the plow being thrown out of the land by the greater pressure on the land side, early inventors placed the beam at an angle to the plane of the land side. John Mears improved upon this method by inclining the standard to the right, and placing the beam directly over the centre of resistance and in a plane parallel to the plane of the land side. The inventions of James Oliver improved somewhat on Mears' construction. If, when the team is attached to a plow otherwise properly adjusted, it is found that a line drawn from the centre of resistance to the point of draft at the horses' shoulders passes through the point of attachment at the beam, the greatest economy of power and ease of holding will be obtained. It can be seen at once that this is true, for, if the attachment were above, the plow would be inclined deeper in the ground, and if below, it would be easily thrown out.

Use of Wheels.

The plow is not a perfect implement, because the pressure of its three sides tends to make the soil more compact, when it is desired to make it mellow. This is especially true of the bottom of the furrow. An effort has been made to reduce the friction on the sole by placing a wheel at the back part, between the land side and the mold-board, but it was found that the wheel soon clogged and made the running of the plow unsteady, so that its use was soon abandoned. Another experiment placed two wheels at the end of the beam, one in the furrow and one on the land. This arrangement made the plow run steadily, but the larger wheel in the furrow raised the beam and forced it out too soon at the ends. It is believed that Zadock Harris was the first to use one wheel to travel on the land, — an arrangement almost universally adopted in walking plows. This wheel is merely to give a uniform depth of furrow and steadiness in running. If it is found that it presses hard on the land, the team is not prop-

erly adjusted and there is loss of power. The sulky plow has this advantage: the wheels support the plow, causing less pressure on the bottom of the furrow, uniform depth and width of furrow, and the plowman can ride. The most advanced form now in use in Massachusetts is the double sulky, of which the National and Syracuse are types. The most popular plow in the west is the tricycle, a plow supported by three wheels, of which the Flying Dutchman and Canton Clipper are types.

Points of a Good Plow.

Every plow is constructed to take a furrow of definite dimensions, and can do good work only within narrow limits. To select a plow wisely, the kind of work desired must be had in mind. Some modern plows are made too narrow between the land side and back part of the mold-board, and in sod the first furrow taken out is too narrow to admit of receiving the second furrow slice. If the furrow slice is of one-third greater width than depth, it will be placed at an angle of 45°. This arrangement exposes the largest possible surface to the action of sun and air, and is considered most advantageous for future cultivation.

Harrows.

The earliest form of the harrow used in this country was undoubtedly the spike tooth fastened in an A-shaped or square wooden frame. This form of harrow appears in the modern smoothing harrows with teeth set at an angle to the frame and turned back, or teeth that may be adjusted to any desired position. The first step in advance was what was known as the shares harrow, — share-shaped teeth, bolted to an A-shaped frame, or a straight plank to be drawn at an angle. This style of harrow may still be found in use, and is being manufactured. A modified and improved form appears in the Acme.

A crude form of disc harrow has been used by the Japanese from very early times. The disc harrow, now so commonly used in this country, has been evolved from harrows patented by H. M. Johnson and S. G. Randall, from 1854 to 1859.

In the earliest forms each disc turned on an independent axle. A later form, now become universal, shows two gangs of discs fastened on an arbor, and made to turn in such a manner as to work the soil in opposite directions from or towards a centre. In the most advanced form of this harrow the two gangs of discs are made to overlap at the centre, thus avoiding the untouched ridge and the necessity of overlapping the harrow half way to cover all the land. The different forms of spring-tooth harrows are the result of the invention of David L. Garver, and improved by D. C. Reed of Michigan, from 1869 to 1877. It would be impossible to tell which is the best kind of harrow, — two or three kinds are required to properly fit the land to receive the crop.

Drills and Planters.

Drills and planters place the seed at a more uniform depth than can be the case by hand planting; they also place the soil in a more favorable condition for the germination of seeds. Charles W. Billings of South Deerfield, Mass., invented a corn planter about 1850, and a little later S. E. Harrington of North Amherst, Mass., invented a drill for sowing onions and other small seeds. These machines were largely used in Franklin and Hampshire counties a generation ago, and their ideas are embodied in planters still being manufactured. The Billings machine was operated by the covering wheel in the back part of the machine acting upon sliding rods, which opened and closed cups that measured and dropped the seed in hills. Another machine for planting corn in drills appeared about the same time, known as the Woodward. It was operated from the covering wheel turning a cylinder underneath the seed box by means of a cog-wheel gear. In the cylinder were openings that could be adjusted by screws to regulate the quantity and distribution of seeds. Modified forms of this machine are the Eureka and Eclipse; but it is doubtful if the endless chain gear, which appears in these machines, will prove superior to the old cog-wheel action. The attachment to plant in check rows operated by hand does not appear to me to be practical. If it is desired to plant in check rows, the double-row machine with knotted chain and automatic trip must be superior. Mr. Harrington

made his first machine about 1864, for a friend, who was the pioneer onion grower of Sunderland, and a former member of this Board. It was a combination drill and cultivator. The distribution of seeds was regulated by a dial plate, with different-sized openings for different varieties of seeds, placed under the seed box, in which was placed an agitator kept in motion by a rod acted upon by the forward wheel. A later machine of this type is the Mathews drill. Their chief fault is found in the fact that they offer little chance of adjustment for different-sized seed of the same variety. Superior in this respect are some of the later drills, with an adjustable opening, for all varieties of seeds. Another improvement is a forced feed gear. The Southport double row drill, with adjustable revolving cups, is a popular onion sower.

Weeders and Cultivators.

The weeder is of very recent introduction, and I have yet to see any marked good resulting from its use. I believe that more efficient work can be done with the two-horse, spring-tooth cultivator, or any of the best single cultivators, by starting work as soon as possible after planting, and continuing the operation as often as possible until the crop is well advanced. The cultivator is a simple implement, and admits of very little change of the principle on which it is operated. The cultivators we have at present penetrate the soil and take hold of tough pieces of witch grass better than the ones used a few years ago, on account of the better construction of the teeth. Improvement has also been made in regard to convenient means of adjustment.

Mowers and Reapers.

In a recent article in the New York "Herald" in regard to progress made in the century relating to agriculture, it is said the most important invention of the century is the harvester. In a recent article in "McClure's Magazine" Mr. Ray Stannard Baker says: "With June the wheat harvest in the United States begins in earnest, and from that time until the first of September there is not an hour of daylight when the click of the harvester is not heard." The credit for the invention of the harvester belongs to two farmer boys

of De Kalb County, Illinois, in 1858, though many others have contributed something to its present form. The first harvester was an attachment to a reaper, carrying the cut grain to a table, where it was bound by hand. The efforts of S. D. Lock and John F. Appleby, from 1861 to 1876, were largely instrumental in working out the problem of an automatic wire or twine binder.

The cutting of grass and grain by machinery was being thought of in England a century ago. In 1822 Henry Ogle, a schoolmaster of Rennington, England, with the aid of the Brown Brothers, who were founders, built a machine which shows many features of the modern reaper, and was probably the first successful machine of the kind. The cutting arrangement employed in the first attempt at reaping and mowing machine manufacture in this country was in the form of a revolving scythe. The machine of Jeremiah Bailey, in 1822, and improved by E. Copes and J. Hoopes, in 1825, was of this type. Mr. Copes's son, writing of this machine in 1854, says: "This was a very efficient machine, but used chiefly for cutting grass; and it would cut an acre in thirty minutes better than it possibly could be done by hand." It would seem that in this case the fittest did not survive. The inventions of Obed Hussey, in 1833, and of Cyrus H. McCormick, in 1834, first introduced the form of cutting bar with vibrating sections passing through guards or fingers, as is common with all subsequent harvesting machines. In Mr. Hussey's first machine the guards were closed on top and brought back to the finger bar, leaving no opportunity to clear, and causing the machine to clog quickly. This fault was remedied by cutting off the back part of the upper side of the guard. Many of the earlier machines were combined reapers and mowers. The first machine which I recollect was the one used by my father. This was a combined machine, known as the William A. Kirby, bought in 1859. It had one driving wheel, with rigid bar. The frame of the machine was balanced on the driving wheel in such a manner that the driver could by changing his position raise or depress the bar. By this means, and by means of a lever operating a wheel at the outside of the bar, it could be raised five or six inches from the ground. My father says of this

machine: "It would do good work while going ahead, but was difficult to turn and almost impossible to back, it not being provided with ratchet and pawl gear." For reaping there was a reel and table attachment to receive the grain, and an additional seat for a man, who raked off the bundles. The modern reaper is an improved form of this machine, with automatic raking device. The invention of the two-wheeled hinge bar mower has proved more convenient for cutting grass.

R. T. Osgood of Maine, in 1852, invented a machine with two driving wheels on a common axle, with ratchet and pawl gear, so that each wheel would be in gear when turned back. This machine was provided with hinged bar and lever, so that the driver could raise and depress the bar while the machine was in motion. Lewis Miller of Canton, O., invented the plan of taking power from the main axle instead of from cogs on the driving wheel, a plan generally adopted in the best mowers of to-day. He also, from 1856 to 1858, improved upon the hinged bar arrangement, and invented the peculiar folding bar and adjustable pawls known in the Buckeye type of mowers. The hinged bar proved an advantage in point of convenience in operating, but lost in economy of power as compared with single-wheel machines; and, while the latter often cut five or six feet, it was found that only four or four and one-half feet with the hinged bar that dragged heavily on the ground was practical. By supporting the bar on the driving wheels and on a small wheel at each end, and by careful adjustment of the pitman so that it will be in line at all positions of the bar and not bind on the crank pin at any time, what is known as the floating bar has been introduced by leading manufacturers, so that now a mower cutting five or six feet is easily handled by an ordinary farm team. A farmer who has fifteen or more acres of grass to mow in a season is no longer justified in using a four-foot cutting bar. The addition of first cost is of trifling consideration, as compared to the saving of one to one and one-half hours for a man and team in the forenoon during the busy season of haying. I have used a six-foot bar for several years, and figure it has cost about twenty-five cents an acre for use of the machine.

In the best machines the bar is hung at right angles to the frame, and the pitman and bar should always be in line. It should have the most advanced devices for overcoming friction, and taking up wear, and convenience of handling. Probably no machine is superior to all others in every particular; and the different points of superiority of a mower or any machine can be determined only by carefully conducted field trials, in which the relative amount of draft is determined by actual test with an instrument.

There were held, during the early days of the history of the mowing machine and the improvement of the plow, some famous field trials, — one at Geneva, N. Y., in 1852, one at Syracuse, N. Y., in 1857, and one at Utica, N. Y., in 1867. Nearly all the machines then made contested. A copy of the report of the judges, who were many of them men of eminent ability, is in the library of this Board, and is well worth a careful study, especially the parts relating to their method of awarding the prizes. I would suggest that an improvement might be made by the use of a score card, arranged to give the different points of excellence a relative value.

Every modern machine represents a number of inventions which may be traced back to their origin. Here has been truly an evolution. It is difficult to imagine what would be our condition if we had only the machines in use at the beginning of the century. It is safe to say that the production and harvesting of six hundred million bushels of wheat and eight hundred million bushels of corn would be out of the question. The men whose efforts contributed to this progress should be regarded as benefactors and promoters of the cause of liberty and the mastery of man over the forces of nature. These men should be held in honor, and their memory cherished by every friend of American agriculture. Oftentimes the introduction of improved machines has been resisted for fear laborers would be thrown out of employment, and a large number of inventors have failed to receive any adequate material reward. The Hon. William H. Seward says, of Jethro Wood: "No citizen of the United States has conferred greater benefits on his country; no one of her benefactors has been more inadequately

rewarded. Others who combined large business ability with inventive genius have succeeded in building a monument to themselves in the great manufacturing industry which bears their name."

What of the Future?

The problem of the application of steam to the heavier operations of the farm has been studied for the past fifty years, but nothing practical is at hand that is within the reach of any but the bonanza wheat growers. If we may judge by what is taking place in other industries, we may confidently expect that the improvement of steam power, electricity or some other form of motor will be adapted to the farm during the early part of the twentieth century. The old traction engines were too cumbersome, and wasted too much power. The arrangement of fields in many New England farms is not as favorable to the use of machinery as might be desired. One continuous field of considerable size can be cultivated much more cheaply than two fields of the same area. In this respect farmers of the west have enjoyed an advantage greater than the superior fertility of the soil warrants; and the natural conformation of the land there is adapted to the use of all labor-saving machinery on the broader lines of future development. Nevertheless, the farmers of New England may often find it convenient to co-operate in the ownership and use of the more expensive machinery.

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SPRAYING OF CROPS FOR PROFIT.

BY PROF. S. T. MAYNARD, POMOLOGIST TO THE BOARD.

The longer any crop is grown in one locality, or the greater the extent to which it is grown, the more will it be subject to injury by insect and fungous pests. It is often remarked that the number of insects and fungous pests is rapidly increasing, and this is too often true; so rapidly do they sometimes increase that our crops would be total failures did we not promptly apply remedial or preventive measures.

One season, under conditions favorable to their increase, insects and fungi are abundant, doing serious harm; while in another season the conditions are such that these pests are destroyed by cold, by too much moisture, by scant food supply, by parasites or other enemies, and little or no damage is done.

We sometimes have a series of years when insect and fungous pests are abundant, and also those when no injury is done. In the first case we are liable to become discouraged, while in the second we are led to think that it is all a matter of chance, and not worth while to make an attempt to protect our crops.

This is, however, an unthrifty method of doing business. Our crops may escape injury this season, and possibly for one or two years longer; but there is scarcely a crop we grow that is not at one time or another injured by one or both of the above-named pests, and there are few, if any, crops that we grow upon which there is so much profit in growing that we can afford to lose even one crop. There is but one safe business principle for the farmer, fruit grower or gardener to follow, and that is, to be prepared with and apply preventive measures whenever the conditions are favorable for the development of insects and fungous pests.

Most Farm and Garden Crops can be saved by Spraying.

There is hardly a farm or garden crop that cannot be saved from serious injury from insects or fungi, and that at a cost which will leave more margin for profit one year with another than if no spraying is done. The work of spraying will, of course, add something to the cost of any crop; but when one's crop is injured, the same crop of other growers is in danger, and, the majority of growers not being active and prompt in the work of prevention, the total crop of a section is likely to be small, which will ensure higher prices for those who do produce a perfect crop.

The Apple.

The apple crop can be saved from injury by the canker worm, a pest too well known to need description, the codling moth, the insect that causes the wormy apples, the tent caterpillar, the bud moth and many other insect pests, by spraying with Paris green; while the apple scab, a fungous growth that causes the olive-colored spots on the fruit and often causes the leaves to turn yellow and fall off, the cedar-apple fungus and other fungous pests may be destroyed by the use of the Bordeaux mixture, the two substances being combined and used at one application.* This has been proved by numerous careful experiments made at several of the experiment stations and by many progressive orchardists in various parts of the country.

The Pear.

The pear tree psylla can be kept under control by the use of kerosene properly applied, as has been shown by the experiments made by Dr. Jabez Fisher of Fitchburg, and by the experiments made at the Cornell University and Massachusetts experiment stations. The wormy fruit is

* In Bulletin No. 60 of the Hatch Experiment Station, Amherst, Mass., may be found a full explanation of the different insecticides and fungicides, together with the routine for spraying all fruits, farm and garden crops. These bulletins are sent free to any one living in the State who requests them. This number should be preserved for future reference, if it has already been received.

Plate I.—Plum tree sprayed.

Plate II.—Plum tree unsprayed.

prevented by the use of Paris green, and the leaf blight and cracking of the fruit by the use of the Bordeaux mixture and copper sulphate solution.

The Plum.

The fruit of the plum may be largely saved from injury by the plum curculio by the use of Paris green, and the injury to the tree by the black knot and the leaf blight and to the fruit by the monilia or brown rot may be prevented by the use of the Bordeaux mixture and the copper sulphate solution. Plate I. illustrates a plum tree sprayed, and Plate II. one of the same variety unsprayed. The large crops of plums that are borne on the trees in the Hatch Experiment Station orchards, some trees of which are over thirty years old, and their freedom from the black knot are proofs of this assertion. The aphides that have been so destructive to the plum in the past two seasons can be destroyed by the use of the kerosene emulsion or kerosene and water. A pump for the use of kerosene and water is shown in fig. 1. The Japanese plum trees cannot be sprayed with Paris green after the foliage has opened, and, as an arsenate is necessary for the destruction of chewing insects, arsenate of lead must be used.

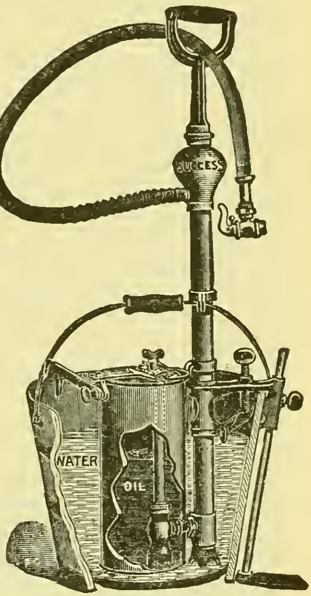


Fig. 1.

The Peach.

This fruit, while not so much benefited by spraying as some of the other fruits, may be sprayed with the Bordeaux mixture to prevent the leaf curl, the shot-hole fungus and the rotting of the fruit. Paris green cannot be used on the peach, but the arsenate of lead may be used for the destruction of the plum curculio. The peach aphis, which causes

the leaves to curl up during the summer, may be destroyed by the use of kerosene emulsion or kerosene and water, which must be applied with as much force as is possible, that it may penetrate under the curled leaves.

The Cherry.

The cherry aphis, the minute black insect which causes the leaves to curl and stops growth, can be kept from doing serious injury by the use of the kerosene emulsion or kerosene and water, or by cutting off a few leaves on the ends of the growing branches. The rotting of the fruit just as it begins to ripen may be prevented by spraying after every rain for a week or two about the time the fruit is ripening with the copper sulphate solution, four ounces to fifty gallons. The cost of this work at first would seem to be more than an ordinary crop would be worth; but the liquid is inexpensive, costing only from one to two cents per barrel besides the labor of application, and with proper appliances and economy of labor the spraying can be done for a very small sum per tree for the short time when it is necessary to spray. Mr. Geo. S. Powell of Ghent, N. Y., writes that he saved a large crop of cherries during the summer of 1898, a season of unusual rainfalls, by the above treatment. Paris green cannot be safely used on the cherry foliage, but arsenate of lead should be used for the plum curculio and cherry maggot.

The Quince.

The leaf blight and rust on the branches and fruit can be prevented by the use of the Bordeaux mixture. This should not be applied, however, after the fruit is more than one-half grown.

The Grape.

Most of the insects attacking the grape, except the phylloxera, which seldom injures the American grape, can be destroyed by the use of Paris green, and the black rot, the downy and powdery mildew and the anthracnose are all prevented from doing harm by the use of the Bordeaux mixture and the copper sulphate solution. The former should never be used after the berries are one-half grown. One of the greatest difficulties in growing the grape in New

Plate III. — Vine sprayed.

Plate IV. — Vine unsprayed.

England is the weakening of the vines by the fungous pests; and vines regularly sprayed to prevent this injury gain in strength from year to year, and large and satisfactory crops are the result. We have to compete with fruit from the large vineyards of more favorable grape-growing sections than New England; but the native fruit, when well grown and ripened, can be put upon our local market in so much better condition than that coming from a long distance that it is sure to bring a much higher price. Plate III. illustrates a sprayed and Plate IV. an unsprayed vine.

The Raspberry and Blackberry.

The orange rust and leaf blight, the two most serious obstacles to the growth of these crops, are easily kept under control by spraying with the Bordeaux mixture.

The Currant and Gooseberry.

The currant worm is destroyed by the use of hellebore powder applied in water, or in a dust form when the leaves are wet with dew or rain. Attention should be given to the bushes very soon after the leaves open, and spraying be done upon the first appearance of the worms. The leaf blight, a fungus that causes the leaves to fall off in August, may be prevented from doing injury by the use of the Bordeaux mixture.

The Strawberry.

While spraying for the destruction of insects and fungous pests attacking this fruit does not give so marked results as with many other crops, it has been conclusively shown in many experiments that the rust is largely reduced by the use of the Bordeaux mixture; and the two insects, the black paria and the crown borer, may be largely prevented from doing serious harm if Paris green is used in the mixture.

The Potato.

Numerous experiments and general practice go to show that this crop cannot be grown with the best results without the use of insecticides and fungicides. The Colorado beetle and the flea beetle are destroyed by the use of the Bordeaux mixture and Paris green, and at the same time the leaf

blight and the potato rot fungus may be largely, if not entirely, prevented. The growth of the potato scab on the tuber can be largely prevented by the use of corrosive sublimate or sulphur.

The Tomato.

The injury to the tomato crop from the rotting of the fruit and the blight of the leaves can be largely prevented by the use of the Bordeaux mixture.

Celery.

While the success of this crop depends largely upon an exceedingly rich soil and an abundance of moisture, the numerous fungous pests that often injure the crop under many conditions may be kept down by the frequent use of the Bordeaux mixture. The plants should be sprayed in the seed bed as well as in the field in order to insure the best results.

Other Crops.

The onion rust, grain rust and smut, asparagus rust and many blights, rusts, mildews, smuts, etc., that attack other crops, and the many insect pests may also be kept under control by spraying; and no thrifty cultivator can afford not to insure his crops at least to the extent of equipping himself with apparatus for the application of insecticides and fungicides, and to have on hand the materials necessary for their use and also one or more of the numerous spraying calendars issued by some experiment station or printed in the agricultural papers.

Equipment for Spraying.

Perhaps the reason why so few are making use of insecticides and fungicides to protect their crops is from the idea that it requires especial skill and expensive apparatus to properly spray their crops. Spraying is one of those operations, however, that is simple enough in itself, materials are generally easily obtained, and directions for the work are spread broadcast throughout the land; but the work looks larger, perhaps, than it really is. With a good pump, good nozzles and a fair degree of intelligence and mechanical skill, the operation is neither difficult nor expensive.

There are many good pumps and nozzles to be had at reasonable prices, any one of which will be a good investment to the farmer, fruit grower or gardener. We cannot advocate any one pump as superior to all others. All pumps of whatever kinds in which copper sulphate is used must be made of brass, as iron would be soon so corroded as to be worthless.

Kinds of Pumps.

The pumps in most general use may be put in four groups: (1) the hand pump, either the syringe or pail pump or atomizer (figs. 1 and 2); (2) the knapsack (fig. 3); (3) the barrel pump (figs. 4 and 5); and (4) the machine pump.*

The Hand Pump. — For garden work, where only a few plants, shrubs or small trees are to be protected, the common hand pump represented by fig. 1 (without the kerosene attachment) will be found sufficient.

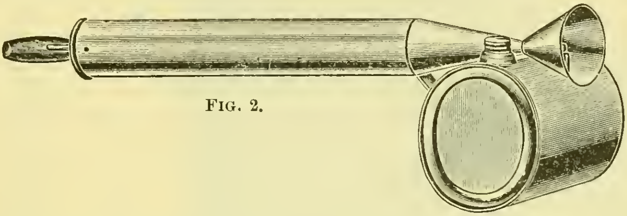


Fig. 2.

The atomizer (fig. 2), of which there are many forms that are practically the same in construction and utility, is very useful and inexpensive. For the use of the Bordeaux mixture or copper sulphate solution it must be made of brass or copper.

The knapsack (fig. 3) is useful when a larger amount of shrubs or small trees are to be treated, and when they are too closely planted to allow the barrel pump to be driven through on wheels or on a stone boat. These pumps hold about five gallons, and can be easily carried on the back. The main objection to them is the cost, which is from twelve to eighteen dollars, complete, with hose and nozzles.

* Editor's Note. — Attention is called to the article "Improvements in spraying machinery," included in the report of the gypsy moth committee of this Board, and to be found on pages 469-474 of "Agriculture of Massachusetts" for 1898.

The Barrel Pump. — This is by far the most economical and satisfactory kind of a pump for general use. The pumps are mounted either on the side or end of the barrel (figs. 4 and 5); we prefer the former, because the barrel can be more easily kept in place on the stone boat or in the cart. It is carried about in a cart or wagon, on a stone boat or on a single pair of wheels, and with a piece of half-inch iron or brass pipe ten feet long the tops of the highest fruit trees may be reached with the spray. If tall, ornamental trees

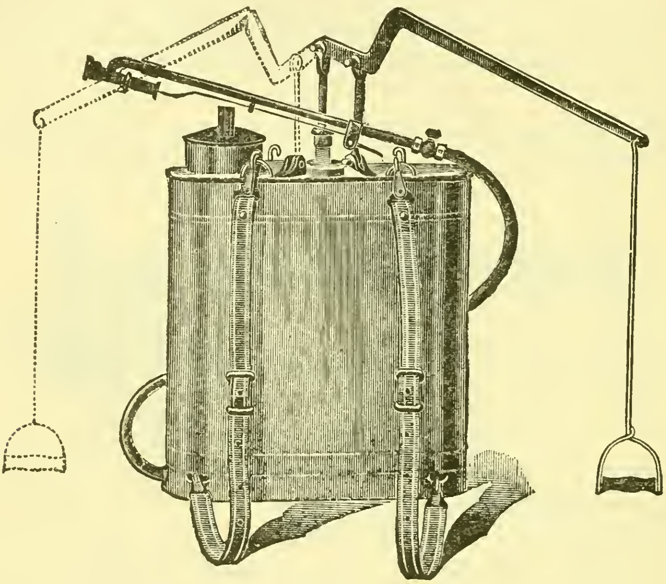


FIG. 3.

are to be sprayed, the hose must be carried up into the branches and the spraying be done from them.

A kerosene attachment is provided on many of the barrel pumps, by which kerosene and water are forced into the hose at the same time, and distributed from the nozzle in a fine mist or spray. As far as has been tested, this seems the best method of applying kerosene. In fig. 1 is shown a kerosene attachment to the pail pump. When but a small amount of spraying with kerosene is to be done and only on low shrubs or plants, the atomizer (fig. 2) will do the work as effectually as the more expensive appliances.

Machine Pumps. — For the varied work of the average New England farmer or horticulturist, these pumps cannot be used as economically as the barrel pump; but where large areas of potatoes, vineyards and young orchards are to be sprayed, their use may be made profitable. The same may be said to a greater degree of the steam sprayers.

Nozzles. — Much of the success in spraying depends upon the kind of nozzle that is used. Fig. 6 illustrates the Vermorel nozzle, and fig. 7 the Bordeaux nozzle, both of which throw the liquid out in a very fine spray. In using these nozzles all coarse particles of lime or other substances must be strained out of the liquid.

Fig. 4.

Insecticides.

Insecticides or insect destroyers may be divided into two groups, *i.e.*, (1) those for killing chewing insects, like the potato beetle and its larvæ, the larvæ of the canker worm, etc., and (2) those for killing sucking insects, like the aphides (plant lice), the pear psylla, the black squash bug, etc.

In the first group are Paris green, London purple, arsenate of lead and hellebore.

Paris Green. — This is the most generally known and one of the most effective insecticides. It is used in a solution of one pound to one hundred and fifty gallons of water, or in a dry powdered form with bellows or guns, and in the latter form it must be applied when the foliage is more or less wet with dew or rain. If used too abundantly, and the weather following is very wet, serious injury often follows. Numerous substitutes for this insecticide have been offered in the market under various names, but none of them have proved of sufficient value to be recommended.

London Purple. — Owing to the variable nature of this substance, it has not come into such general use as has Paris green. Upon crops that are not injured by the soluble arsenious acid it contains it may be safely used.

Arsenate of Lead. — The peach, Japanese plum and the cherry foliage are injured by the use of Paris green; but the arsenate of lead is said to be equally as effective as the latter, and not injurious to the foliage, even when used in large quantities.

Kerosene. — Up to within a year or two this insecticide has been used in the form of kerosene emulsion, and with

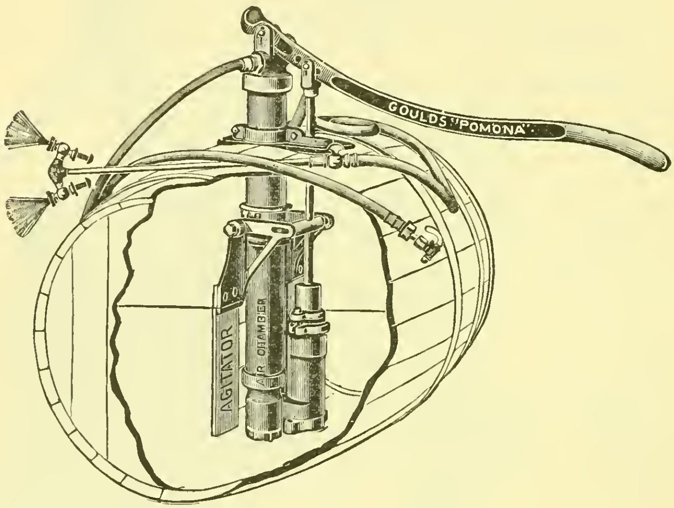


FIG. 5.

good results; but some difficulty seems to have been experienced in making a reliable emulsion under various conditions, and injury has often resulted. It has been found, however, that clear kerosene or kerosene and water, applied in a fine spray or mist, and on *bright, airy days*, is safe, more effectual and not more expensive, when the labor of making the emulsion is considered. Neither the emulsion nor the kerosene and water should be applied in moist, cloudy weather.

Pyrethrum. — This powder, called also Persian or Dalmation insect powder, is an insecticide that acts very quickly upon the breathing organs, killing delicate insects like the

cabbage worm, currant worm, etc. If applied just at night it is much more effective than when applied in the morning, especially if the weather be bright and airy.

FUNGICIDES.

Fungicides or fungi destroyers are substances that prevent the growth of the spores or seeds of the various lower plants, the rusts, blights, smuts, mildews, etc., called fungi, that feed upon and destroy our farm and garden crops.

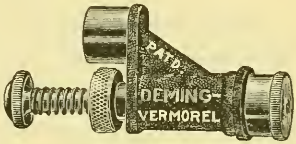


FIG. 6.

The most important of these is copper sulphate or blue vitriol, sometimes called blue stone. A fungous plant growing within another plant and taking its nourishment from that plant, as most of the fungi do grow, cannot be destroyed without destroying the host plant; but its spores or seeds will be destroyed if they come in contact with even a very small amount of soluble copper. The main object, therefore, in the use of copper solutions, is to have the substance spread over the surface of the foliage or branches, so that the spores which are floating in the air may be destroyed when they fall upon a tree or plant that is in condition to allow of their growth.


FIG. 7.

Copper sulphate is used in two forms, *i.e.*, the Bordeaux mixture and copper sulphate solution.

Bordeaux Mixture.—Full directions for making and using all insecticides and fungicides are given in Bulletin No. 60 of the Hatch Experiment Station, already referred to, and need not be repeated here. Should any reader of this paper not have received this bulletin, it can be obtained by sending a postal to H. H. Goodell, director, Amherst, Mass. The Bordeaux mixture is the fungicide most universally employed upon all crops when the disfigurement of the foliage or fruit is of no consequence, and is especially valuable because of the long time that it will adhere to the foliage, and gradually give out enough

of the copper solution with each rain to kill all ordinary spores.

Copper Sulphate Solution. — This is used while the trees are dormant, one pound to twenty-five gallons of water, and when the foliage is upon the trees or plants at one-quarter pound to fifty gallons of water. In this form the copper is very soluble, quickly washed off by heavy rains, and it is therefore necessary to spray after every heavy rain.

Conditions of Success.

The secrets of success in this work are: (1) in the ability of the operator to fully understand his machines or pumps, and keep them in good working order at all times; (2) to understand the preparation of the insecticides and fungicides, and the economy of time in getting them ready for use; and (3) in the thorough and rapid application at just the right time.

PRACTICAL HINTS FOR THE DAIRYMAN.

BY PROF. F. S. COOLEY, MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST.

We have just passed one of the very trying seasons of the year for dairymen. The drying up of pastures, falling off of feed, August heat and flies make an adverse combination hard for the average feeder to meet. But improved management has not entirely ignored the needs of the past months, and we are becoming better and better able to overcome these difficulties. The successful dairyman finds it very important to prevent the shrinkage in milk, for it is apt to be permanent. Cows that fall off seriously in milk, owing to short feed, rarely regain their former product during the season, even if food is given later in abundance.

Partial Summer Soiling.

While the writer is not an enthusiast over the soiling system, having experienced some of its difficulties, he is fully convinced of the necessity of providing some supplementary fodder for milch cows during July and August. Against those who advocate green feed throughout the season as more profitable than pasturage, I have no argument to make. I venture the opinion, however, that the novice will often enviously look at his neighbors' pastures during his first attempt at summer soiling. A good pasture is a great convenience on a dairy farm. Pastures do not, however, produce evenly throughout the season. There is always a surfeit in May and June and a shortage afterward. It is good husbandry to stock pastures heavily, so that the early flush of feed may be utilized, as it checks a tendency to "grow wild" that has spoiled so many good pastures. Good husbandry also demands the provision of feed of some sort to eke out the pasture feed in late summer. The best

feeders and most successful dairymen feed some grain throughout the season. Some practice feeding silage in summer very successfully, and certainly at a less expense than soiling entails. It is believed, however, that, in order to be successful, silage feeding in summer must be practised on at least a moderately large scale, and so is not practicable for the small or average feeder.

Hay may be fed successfully, and should be fed rather than let milch cows go hungry. On arable farms hay forms an expensive feed, as a rule, and economy dictates only a sparing use of it at any season. More than this, cows do not do so well on hay in summer as on a more succulent diet.

The average dairyman, whose farm may be tilled without great labor, will find it good practice to grow green crops as an adjunct to his summer feed.

Soiling Crops.

Rye. — One of the earliest soiling crops is rye. It may be grown so as to become available as a feed by the 10th of May. A succession may be secured by sowing at intervals from September 10 to the middle of October. Feeding should commence before the heads are in sight, as rye rapidly deteriorates as a fodder and becomes unpalatable after it gets headed out. At its best rye is a very watery feed, not especially nutritious, and requires supplementary fodders of a dryer and more concentrated nature. Its principal value as a feed lies in its early appearance, hence it should be left out of a partial soiling system for late summer.

Clover. — Few forage plants surpass the medium red clover in practical utility. It possesses a value not likely to be over-estimated, being palatable and nutritious to the animal, and beneficial in its effect upon the land. Red clover easily follows rye, makes a heavier growth of forage, and may be cut two or three times during the season.

I would advise feeding clover with a certain degree of moderation, and preferably in conjunction with other fodders, *e.g.*, millet or corn. Being very rich in protein, clover requires less of concentrates to complete the ration than most coarse fodders, hence the supplementary feed may be of a more starchy nature. Corn meal goes very well

with clover, and the two make a ration well suited to milk production. On account of the difficulty of securing a really good clover hay, and the waste and loss so often experienced, it seems to be good practice to feed clover green to as great an extent as can be advantageously done. The first cutting of clover comes at a time when pasturage is in full flush and extra forage not so much needed, but the after-cuttings are very acceptable additions to the milch cow's bill of fare.

A word on the treatment of clover may not be out of place. Belonging to that group of plants that possess the quality of bringing down valuable nitrogen to the soil, clover does not require so much nitrogenous manure as many crops. On the other hand, the mineral elements, phosphoric acid and especially potash, are particularly beneficial to clovers. I have observed repeatedly that the application of wood ashes or muriate of potash to grass lands serves to increase the proportion of clover. This fact should be borne in mind when seeding down, and manures containing a preponderance of potash used when clover is desired. The oft-repeated statement that this crop benefits the land will bear repeating and emphasizing. Both directly by the nitrogen it leaves in the soil and indirectly by what it adds after being fed to farm animals, clover serves to increase the fertility of the farm. Dairymen should grow and feed as much clover as possible.

Grass. — As a convenience, grass may be fed to cows during haying time, either green, half dry or as new hay. It is at this season, and from seed time up to this season, that labor is in demand on the farm and that the greatest difficulties to the soiling system present themselves. If the pastures will take care of the dairy cows until haying is done, there is usually leisure to provide for them afterwards. While haying is in progress, a ration from the newly cut grass may be fed with little extra labor, and it will be relished and well paid for by cows coming in from pastures already beginning to produce less bountifully.

Oats. — Following the hay crop, and the first crop of the season's sowing, oats form a valuable supplement to pasturage during the early part of July. They are relished by all

classes of stock, are nutritious, succulent, and have a very beneficial effect on milk production.

If peas or vetch are sown with the oats, an increased value is obtained by reason of the larger percentage of protein in the crop and the enrichment of the land in nitrogen, peas and vetch having the same effect as clover. I would recommend for forage purposes the sowing of three pecks to a bushel of vetch per acre on moist land with oats, and a bushel or a bushel and a half of peas on dryer land.

The oat crop requires liberal manuring and likes nitrogenous manures particularly; but, owing to its growth habits, fresh application of green manure is not likely to prove as beneficial to it as to succeeding crops. Manure should be well rotted for oats, or perhaps, better yet, applied the preceding autumn. This method allows the nitrogen to become available, which is not the case to so great an extent if green manure is used when the seed is sown. Fresh manure should rather be used with crops making a later growth, as, for example, corn. While the latter crop is making its heaviest growth during the last part of summer, nitrification is going on most rapidly, and the greatest possible benefit from the application of stable manure is obtained. Something of a succession may be secured by sowing oats at intervals, but it is not practicable to prolong the season of feeding this crop very greatly, as other heavier yielding crops may now be secured.

Millet. — Among the newer and less familiar forage plants, millet is already recognized as one of growing importance.

Of the varieties of millet, the German and Hungarian are perhaps most familiar in this country, although the Japanese varieties are rapidly coming to the front. Through the efforts of Prof. Wm. P. Brooks of the Massachusetts Agricultural College, the introducer of the Japanese millets, Massachusetts farmers have already learned much of their value and are proving their merits. While other of these Japanese varieties may be of greater value for special purposes, the one that has thus far proved superior as a forage plant is the barn-yard millet (*Panicum crus-galli*). This millet, sown the middle of May in strong, well-drained land, and given liberal treatment, makes a rapid and heavy

growth, and is ready to feed the latter part of July and the early part of August, — three or four weeks earlier than corn can be fed to advantage. At maturity the stalks stand five to seven feet high, and should cut from twelve to eighteen tons per acre of green forage. The stems are not woody as are those of some of the other varieties, but are succulent, tender, and eaten with great relish by cows.

As millet is somewhat watery, it may be fed to advantage in conjunction with green clover or hay and a moderate ration of grain.

If pastures are large, there is likely to be an abundance of dried June grass, so that the cows will regulate their ration themselves by supplementing their millet feed with what the pasture affords.

The treatment for millet is between that for oats and Indian corn. The land should be mellow, in fine tilth, and manured in the fall, or with well-rotted manure in the spring. After harrowing in two pecks to a bushel of seed per acre, it is well to roll the land after seeding, so as to give a hard surface for cutting. The quantity of seed depends somewhat on whether the land is free from weeds or not, land very free from weeds requiring less seed than weedy land.

Supplementary manures rich in nitrogen and potash may be substituted for barn-yard manure in part. Cutting should commence as soon as the heads appear and continue so long as the plants are green. Haying this kind of millet is attended with much difficulty, and is to be avoided, if possible. I would not grow more than could be fed green to advantage, unless it is convenient to ensile it, in which case it is entirely satisfactory, though slower and more expensive to handle than corn.

Indian Corn. — No forage plant in the corn belt of America can equal Indian corn. Every dairyman is largely dependent upon it for his supply of both coarse forage and concentrates. Not only are the gluten and various corn feeds the cheapest concentrated fodders the milk producer can obtain, but the value of corn fodder fresh, dried or ensiled becomes yearly more apparent. The "cow to the acre" problem comes nearer its solution in corn than in

any other crop. The adaptability of soil and climate, the certainty of a crop, the usual heavy production and the ease and economy of culture, all dictate the general cultivation of a good acreage of corn, while the animals fed are all partial to it in nearly every form. Whatever the crop system pursued, whether soiling, pasture, or any hybrid of the two, a liberal provision of corn fodder for the month of its maturity is the best possible practice.

The problem for the dairyman to consider is, not whether to grow corn or not, but How much corn can my cows get away with? for, the more corn the farmer grows and feeds the more independent is he of feed markets, and the fuller his pocket-book at the end of the season.

Always calculate to have a full supply of corn fodder, from the first variety that forms an ear till a week or more after frost has stopped its growth. A succession should be planned, so that corn may form the staple fodder as long as possible. Select the earliest varieties that make a passable growth, follow with medium early varieties making a larger growth, and finally finish the season with the largest sort that comes to maturity. The cow's taste is not to be overlooked in the selection, and a decided preference may be observed for the sweet varieties over the flint corns, and especially over dent varieties which have too coarse, woody stalks to feed to the best advantage.

Some fallacies in corn culture are prevalent. One of the common ones is that of too thick planting. The maximum feeding value is obtained in corn making a full ear. The ideal planting secures just as many stalks as will produce fully developed ears. If corn is sown so thickly that no ears form, neither the quantity nor quality of forage are increased, and there is a loss of seed. Another common notion that corn in blossom is in its best feeding condition is an error. Corn never improves in feeding value faster than from the silk to the glazing stage. Cows fed upon immature fodder do not milk so deeply as when fed upon fodder with ears fully developed, although they consume much more of the former. Immature fodder has so much water that a cow can hardly eat as much as she needs. The rule

should be to get corn ripe as fast as possible for feeding, and feed from the ripest to be had.

Some interesting facts in corn manuring have lately been developed, among the more important of which is the especial benefit of independent application of potash (muriate of potash) to the crop. The stover and grain both are materially increased in central and western Massachusetts by adding potash to the farm-yard manure applied. Corn, as has been previously observed, is well suited in its growth habits to receive full benefit from fresh manure. The heaviest growth comes at the season of rapid nitrification. On the one hand, liberal supply of plant food is received; on the other, waste of fertility is prevented by manuring corn with farm-yard manure.

Ensilage is the cheapest winter feed produced upon our farms, and, while advocating a large provision of corn for that purpose, we insist upon its liberal use as a supplementary feed in the advanced pasture season.

Barley and Peas. — Another trying season for the dairyman is after the frosts have cut the corn and before cows are put upon winter feed. Pastures are short and feed grows very slowly. The resort of many is to feed off mowings, — a practice that does not find favor with the most successful. The cost of haying is greatly increased when a large area must be gone over in securing the crop. Fall feeding does not compensate the shrinkage of the succeeding hay crop. Hence at this season a crop not affected by early frosts, growing well in cool weather and palatable to cows, has a peculiar value. Barley and peas, or barley alone, may be sown about the first of August, after haying is done, on old land or land newly plowed, manured with the stable accumulations during the summer, and put in fine tilth so that a good crop of forage may be cut after frost has killed corn. About two bushels of barley and a bushel or a bushel and a half of peas per acre is recommended. This forage, though it does not make a particularly heavy growth, is clear gain. Cows eat it with great relish. It is splendid feed for milk production, and bridges over one of the most difficult seasons. One of the strongest advantages of the

crop lies in its immunity from frost. I have had barley and peas continue to grow and keep green after hard frosts were of nightly occurrence, and even until the ground froze stiff.

Summer Silage. — The very decided advantages of summer silage have been lately strongly impressed upon my mind. Unquestionably corn silage is the most economical roughage that the dairyman can feed. Its desirability as a winter fodder has been thoroughly demonstrated, and must be acknowledged by all but the wilfully ignorant. It is only within the last two or three years that the practicability of feeding summer silage has been made apparent.

The writer is lacking in personal experience with summer silage, although he confesses to having caught the fever, and proposes to build a silo for summer feeding in the near future. The unexceptional testimony of dairymen who have fed silage during the summer months is that of great advantage over any other plan.

Summer droughts and death and taxes are about equally certain. As Governor Hoard says, we can't escape the last two, " but with good wit we may dodge some of the effects of the former." The soiling system outlined is in comparison with silage feeding both cumbersome and expensive. More than that, it is the testimony of those who have tried silage feeding during the summer months that their cows keep up a uniform flow of milk in spite of trying conditions, and always relish their silage.

A western creamery owner gathered some facts concerning the shrinkage of milk among his dairies during the drought of 1899. He found that in some dairies, where no supplement to the pasture feed was provided, there was a falling off of 60 per cent in the milk at the time of the drought; in dairies where soiling crops had been provided to tide over the season there was a shrinkage of 15 to 40 per cent, but still a shrinkage in every case; in two or three dairies where an adequate supply of silage was provided and fed during the dry months there was actually no shrinkage at all.

Who does not realize that, if there is anything that will keep up the flow of milk during August and September, the dairymen ought to have it? Just the season when milk is

most valuable, it comes in lightest supply. Yet this difficulty seems about to be overcome by the provision of silage for summer feeding. Forty pounds of silage per day, from July 15 to November 1, means only about 2 tons per cow. A 25-ton silo would be ample for a 10-cow dairy, or a 50-ton for twice the number of cows. What a saving of labor and expense would result from substituting the silo plan for soiling. What a profit from preventing the 60 per cent shrinkage resulting from no such provision. Even 40 per cent of the product of 10 cows for one-third of a year is 400 pounds of butter or 4,000 quarts of milk, reckoned on the basis of 300 pounds of butter per cow per year. Four thousand quarts of milk, at 3 cents, to pay for 25 tons of silage, is almost $5 per ton. What better business does the farm afford than silage at $5 per ton?

Fermentations go on very much more rapidly in summer than in cold weather, so that a summer silo must be somewhat modified from a winter silo. In order to feed fast enough to prevent deterioration of the product, the surface area must be reduced in summer. About 1 vertical foot a week should be fed, or 2 inches per day. It is the experience of those who have tried it that by feeding as fast as that the silage suffers no damage from fermentation. That means that the surface area of a silo for summer feeding should be only about 5 to 7 square feet for each cow fed. Dairymen, consider the question seriously. Can you afford to suffer a 40 to 60 per cent shrinkage every summer, or struggle with soiling crops, to only partially prevent this loss? Can you afford to be without a summer silo?

Cow Stables.

While perchance this presentation of feeding may commend itself at a season when we realize our needs, the time is past for us to remedy present conditions of feed this summer, and it is still early to lay definite plans for next season.

The need of preparing winter quarters for dairy stock will soon be felt, and in the course of the next few weeks necessary improvements and alterations should be made. We see the necessity of good stable sanitation more clearly than formerly. The past few years have taught Massachusetts

dairymen an expensive lesson, and one, therefore, not soon to be forgotten. I do not propose to determine whether the State has dealt wisely or not with its cattle. It may have done both, since it has gone from one extreme of cattle inspection to another in a very short time. Those in charge of the cattle interests in Massachusetts have doubtless learned much in the matter. The least that the State can do is to try and teach farmers the needs of the times with regard to maintaining the health of cattle. We often hear of the good health of the cattle in our grandfathers' times. Tuberculosis was not then invented. Ill health among cows was almost unknown, etc. Perhaps the immunity of that generation is partly in imagination and in the forgetting of many hardships during the years that have intervened. Certain it is, in the human family disease was not then less prevalent than now. The non-existence of tuberculosis in cattle fifty years ago seems rather improbable, if we can credit the statements of *Columella*, made nearly two thousand years ago. This old Roman describes a disease among cattle called "ulceration of the lungs," and says "that they die not, you must bore a hole in the left ear and insert a root of the lung wort."

But, granting that bovine tuberculosis is not "a new thing under the sun," there can be little doubt that our generation has seen far greater loss as a result than has formerly been recorded. This is not because of any radical change in the character of the malady, but rather in a change of the conditions in which cattle are kept. That our cattle are subjected to different conditions from those which formerly obtained no candid observer will deny. The forcing of dairy stock to abnormal production under high pressure has been productive of serious results.

Of these conditions, that of feed, which has been charged with so much influence, we will pass over, merely observing that within reasonable limits the feed, provided it is wholesome and palatable, does not have so adverse an effect upon the health as is sometimes supposed. True, overcrowding the cow with rich feed does often seriously impair her health, but far more often this is in conjunction with too close confinement.

Dairy Cattle need Pure Air. — I have been in stables where in winter weather the air was so warm that a coat was superfluous. The cows were standing huddled together in stalls so low that my head bumped the joists above. The mangers were tightly closed in front, and there were only a few feet between the cows' tails and the side of the building. I computed the air space in one of these stables, and found only 240 cubic feet per cow. If a cow requires only four times as much as a person, this is equivalent to shutting a person in a room 6 feet long, 2 feet wide and 5 feet high. One must not only sleep in such a room, but spend the entire winter there, eating, drinking and never leaving it. To complete the comparison, we must add to such confinement the drain to the system due to maternal functions, which are very severe in the good dairy cow. Is it any wonder that cows kept in this condition are alarmingly subject to tuberculosis? Is it any wonder that the trouble has rapidly increased? The wonder is that we have gotten off so easily for so transgressing nature's laws. The remedy for this evil lies in rational stable management. We must give our cows more fresh air and sunlight. We must clean up the filth, disinfect the old stables, provide proper ventilation and put windows into dark stables.

The State has learned a lesson from the wholesale slaughter of tuberculous cattle, but there is still need of a carefully planned system of inspection which aims at the improvement of stables and seeks to make the conditions in which cattle are kept favorable to overcoming the encroachments of disease.

Three things are necessary for a healthy stable: —

1. Cleanliness (filth is the harbor of disease).
2. Pure air (foul air is a menace to health).
3. Sunshine (the best germicide).

Care of Milk

One of the most important points in successful dairying is neatness and care in the handling of milk. During my study of the creameries in the State I have been struck by the degree of interest which individuals are manifesting in the crusade against slovenliness in the care of milk. The

management of nearly every creamery is considering some means of securing increased care of the cream brought in by the gatherers. Some of these, by dint of constant hammering away and repeated visits to dairies, have accomplished much in securing a better order of things. Others are discouraged by the difficulties offered to the manufacture of good butter from cream carelessly produced. No dairyman who sells his product individually can achieve the highest success if he does not pay great attention to cleanliness in every detail of the handling of milk. The creamery patron must realize that he is serving his own interest as well as that of all members of the association by similar attention to details. Not only do experience and good practice dictate especial attention to cleanliness, but recent scientific discoveries have drawn out the strongest reasons for it in the fact that filth is the harbor of all manner of injurious and destructive bacteria. The keeping quality and commercial value of nearly all dairy products is to a certain extent determined by the cleanly methods in which they are produced.

The need of pasteurization was much emphasized by filthy methods of production, and was at best only a partial remedy for the evil. Good milk, produced in a thoroughly clean manner from healthy cows and kept in a cool and wholesome place, is rarely improved by pasteurization.

Quality of Cows.

While all dairymen recognize the fact that some cows are better than others, and that good cows are more profitable in the dairy than poor ones, few realize the difference in value between the different grades.

Much has been said and written in general terms upon the importance of keeping better cows, but few have attempted an estimate of the amount of this advantage.

Alvord estimates the value of a cow as equal to that of her annual product. On this basis, the average value of cows in the United States is set at $30. The average annual product for dairy cows is 3,000 pounds of milk, or about 1,400 quarts; or, stated in another way, 130 pounds of butter and 1,100 quarts of skim-milk.

At $2\frac{1}{4}$ cents per quart, 1,400 quarts of milk are worth, . .		$31 50
At 20 cents per pound, 130 pounds of butter are worth,	$26 00	
Adding to the above the value of 1,100 quarts skim-milk at $\frac{1}{2}$ cent per quart, ...	5 50	
We get	$31 50	

On the same basis, a good cow is worth $75.

The cost of keeping the average cow in the United States is not far from $30 a year. In Massachusetts both the value of the product and the cost of keeping are somewhat increased, but the net profits remain about the same. In other words, take the country through, the average cow just about pays her keeping. This state of things reduces the profits of dairying to a very small sum on the average, and finds its defence mainly in the fact that the dairyman has found a home market for his crops at a fair price, when without his cows it might be difficult to dispose of them.

It is thus seen that the average cow, producing 1,400 quarts of milk, or 130 pounds of butter per year, will not figure prominently in lifting mortgages from our Massachusetts farms.

It is generally believed, however, that keeping a better grade of cows yields a larger profit. Accepting this as a fact, let us briefly consider the extent to which the value of cows is enhanced by their increased productiveness.

Without gainsaying the close relation between the value of a cow and her annual product, as stated by Alvord, I would like to submit another scheme of valuation, based on the net profit which she earns her owner. This basis of value is as follows: a cow must pay for the feed she consumes and 6 per cent interest, and 2 per cent taxes on her beef value. Whatever is left to her credit, after paying maintenance, interest and taxes, is profit. This profit increases her beef value by the amount on which it will pay interest and depreciation. Six per cent interest is ample, but the depreciation is great in good cows. To prevent loss, sufficient allowance should be made to cover her value in from two to four years. While the average usefulness is more than four years, the risk is so great that it is wise to err on the side of conservatism in estimating values. If we

take the moderate factor of three years' usefulness, then a cow must pay $33\frac{1}{3}$ per cent depreciation on her cost annually. Adding this to the interest, we have 40 per cent, in round numbers. Upon this basis a cow is worth the sum above her beef value on which the profits over her keeping will pay 40 per cent. In other words, the value of a cow is two and a half times her annual profit, added to what she is worth for beef. To illustrate the working of this method: An average cow costs \$30 for annual maintenance, interest and taxes. Her product is worth \$30. She earns no profit, and is worth her beef value, say \$25. A better cow costs \$35 for annual maintenance, interest and taxes. Her product is worth \$41, of which \$6 is profit. Two and one-half times this profit, added to \$25, her beef value, is \$40, which is the value in this case. No one doubts but that the cow which earns her owner \$6 a year profit is worth \$40 to him as quickly as the cow which earns no profit is worth \$25. This is, however, a very conservative statement. If we apply our basis of valuation to some of the better and rarer cows, we shall be more strongly impressed with the desirability of keeping that kind of stock. While the average cow produces only 1,400 quarts of milk a year, or 130 pounds of butter, herds are occasionally met with in which the annual product is 3,000 quarts of milk, or 300 pounds of butter. The cost of feeding in such herds is somewhat more, and very accurate accounts place it at about \$50 per cow. Three thousand quarts of milk at $2\frac{1}{4}$ cents is worth \$67.50, making a profit of \$17.50. Adding two and one-half times this profit to the beef value, we shall get \$68.75 as the dairy value of such cows.

The writer has found even better herds than this, — herds that would average 4,000 quarts of milk, in which the best individual gave 5,000 quarts or more. A 5,000 quart cow yields a product worth \$112.50. If her keeping costs \$75, the profit amounts to \$37.50, and on the foregoing basis her value is \$118.75. There is no doubt but that these high values for the best cows are *real* values. The profits received easily justify the payment of such sums for such cows. More than that, if such cows continue their production for more than three years, there is a very handsome

surplus made which is utterly impossible with ordinary animals.

Know what your Cows are doing. — The difficulty of selecting and maintaining a herd of the best dairy cows lies in the farmers' imperfect knowledge of what each cow is doing. In a general way farmers think they know which is their best cow or which is their poorest, and they have perhaps a fairly accurate idea of the relative excellence of individuals in the herd.

Very rarely, however, is a dairyman well informed on the profit and loss phase of his business. I would strongly urge the recording of each cow's product, by weighing daily, or at regular intervals, the milk, supplementing this information by occasional Babcock tests, and from this data computing the annual product both in pounds of milk and in pounds of fat. Many surprises would come to the dairyman if such records were kept. The cow that started in so big and then went dry four months could be justly compared with the one that maintained a moderate flow throughout the season. It might often be found that neither the biggest milker nor the richest cow gave the largest yield of fat in a year. Some favorites might be found lacking, while some plain, common, everyday cows might prove pillars of their owners' credit. Accurate records of product and cost for each cow are valuable and profitable in many ways.

1. They enable us to weed out the herd, selling the unprofitable members, retaining those that pay dividends and replacing those sold with money-makers. In the absence of such records it is impossible to do this with certainty.

2. They serve as a tab on the milkers. Where daily weighings are recorded, any variation is noticed and traced to its cause. If a cow is not milked clean the fact is discovered. Poor work is in this way discouraged. A larger product will be secured, and the danger of drying off from imperfect milking will be lessened.

3. Disorders in cows are more quickly discovered and checked. If a cow goes off her feed, her daily record gives the first indication, and at that time serious loss can generally be averted; while, if knowledge is delayed until obtained in other ways, serious results are often experienced.

4. It stimulates both owner and help to increase the product to its limit, to do better this year than was done last year, and it educates both alike in matters of dairy economy.

5. It induces business methods in dealing with farms and dairies, — places where business methods have been so much ignored. This is the rock over which many farmers break. One might almost say that the greatest drawback to success in all branches of farming is lack of business methods, *i.e.*, regular balancing of accounts with various farm operations. If commercial houses or manufacturers or builders were as negligent about the record of receipts and expenses or profit and loss in their various transactions as are farmers, their better-informed competitors would soon drive them to the wall. Even the very small leaks in fuel, postage and other items of expense are most carefully studied and guarded against.

Co-operation.

Another great drawback to successful dairying is the lack of confidence between producers. I have not the time or space to discuss its wherefore, but must content myself with the bold statement of facts. *Farmers will not work together.* In all other lines of business co-operation is the rule of the hour, and in it do men find promise of profit. Railroads are fast consolidating, and manufacturers of every sort of product are forming trusts. All lines of business are securing new combines almost daily, and in them do men find relief from the heat of competition. Farmers alone combat each other and play into the hands of their opponents. I have known creamery after creamery ruined because its patrons would not support it. Farmers on every hand sign ironclad contracts with powerful combines, but with each other the most tentative agreements fail to be effective. The proverbial independence of the farmer appears to be his own worst enemy.

THE ELM-LEAF BEETLE IN MASSACHUSETTS.

BY A. H. KIRKLAND, M.S.

In many localities in Massachusetts the imported elm-leaf beetle* has proved a pest of the first rank, and, while but a recent accession to our insect fauna, apparently has come to stay. Since 1895 its depredations in the Connecticut valley have given it considerable local notoriety, and last year at Groton it duplicated the damage caused at Springfield and Northampton.

That this insect will prove a serious pest in the near future in many of our larger cities seems the only conclusion to be drawn from the experience of other States, notably New York and Connecticut. It attacks, and, if neglected, kills, our most valuable species of shade tree, and is slowly but surely spreading over the State. In the present paper the writer aims to set forth the essential facts concerning the insect, in order to aid citizens, and more especially park officials, in detecting and combating it wherever it may occur.

A European Insect.

Like many of our most dangerous insect pests, the elm-leaf beetle is an importation from Europe. Dr. E. P. Felt, State entomologist of New York, who has made quite an extensive study of the literature on this insect, is authority for the statement that it is chiefly injurious in the southern portions of France and Germany and in Austria and Italy, although it is generally distributed over a large part of Europe. The first record of damage by this insect in America is that given by Harris, who states that in 1838 and 1839 it stripped the elms in Baltimore, Md., and vicinity. It is generally conceded that the beetle was introduced in that locality some

* *Galerucella luteola* Müller.

years previous through the importation of European elms. Since that date the beetle has gradually spread southward to North Carolina, westward over the Alleghany Mountains into West Virginia, and northward to the New England States, causing severe damage, particularly to city elms.

Occurrence in Massachusetts.

The elm-leaf beetle appears to have entered Massachusetts from the south several years ago, and has gradually spread northward along the Connecticut and Housatonic rivers. A lateral diffusion of the insect is now taking place in the valleys of the streams contributing to these rivers, and probably along the main lines of our railroads. In Berkshire County severe injury has been caused by the insect at Sheffield and Great Barrington. Mr. H. L. Frost informs me that the beetles are fewer in number and the damage much less in extent at Stockbridge and Lenox, although these towns are more or less infested. The damage to the elms at Springfield has been previously mentioned. Here the insects were injuriously abundant in 1895, their depredations continuing to the present time. In the same year Dr. L. O. Howard found the beetle abundant at Holyoke and Northampton, and in smaller numbers at Miller's Falls. Prof. C. H. Fernald found it at Amherst in 1895.

At the present writing the beetle has spread westward along the Westfield River to West Springfield and Westfield, and along the Mill River to Williamsburg, in each of which towns it was locally injurious in 1898. In the present year outbreaks of the insect have developed at Longmeadow and at Chicopee.

Previous to 1898 eastern Massachusetts escaped damage by the elm-leaf beetle. So far as known to the writer, the only specimens of the insect taken in this region before 1898 were the ones found by Prof. F. M. Webster "north of Salem" in 1895, by Frank A. Bates at Winthrop in 1896, and by the writer at Plymouth in the latter year. That the insect has not been seriously injurious in Boston and its older suburbs has been a matter hard to understand, for the many compact plantings of English elms in this region offer ideal conditions for the insect's development, while the numerous

railroads terminating here afford ready means for its transportation. It seems, however, that we are not always to remain free from injury by this pest, for in 1898 a severe outbreak occurred at Groton, only thirty miles to the northwest of Boston; while the insect was also abundant, though in less numbers, at Ayer, on the main line of the Fitchburg Railroad. During the present season the writer has taken the beetles at Malden, while Mr. A. F. Burgess found a number of the larvæ at Newton, near Brookline, on trees bordering the Newton boulevard. It will be surprising, indeed, if the insect does not appear in injurious numbers in Boston and vicinity in the course of a few years.*

Life History.

The mature beetles pass the winter in various sheltered places, under clapboards, in buildings, etc., in some cases crawling into houses in such great numbers as to cause much annoyance. In this region they emerge from the first to the middle of May, and feed greedily upon the elm, eating innumerable shot-holes in unfolding leaves. Egg-laying commences in a few days and extends over several weeks. Of two female beetles observed by Dr. Felt, one deposited four hundred and thirty-one eggs in twenty-seven days, the other six hundred and twenty-three eggs in twenty-eight days. The eggs are spindle-shaped, orange-yellow in color, and are laid in irregular rows on the under side of the leaves, in much the same manner as the eggs of the potato beetle, an allied insect. The young larvæ emerge in about one week (from late in May to the middle of June), and attack the under surface of the leaves, gnawing away the epidermis and causing the leaves to turn brown. From two to three weeks are required for the completion of the larval stage, at the end of which period they are about one-half an inch in length, of a yellowish color, with a dark-brown or black stripe on either side. They then descend to the rough bark of the tree or to the ground and transform to pupæ. From five to ten days are spent in the pupal stage, varying according to the temperature, when the mature beetles emerge, feed, pair and lay

* Since the above was written the elm-leaf beetle has caused serious damage at Worcester, Hudson, Auburndale, Framingham, Lawrence, Salem and Quincy.

eggs for a second brood, which matures in the late summer. The beetle is from one-fourth to three-eighths of an inch in length, pale yellow, with a black stripe on the outer part of each wing-cover. I have not been able to observe the transformations of the second brood, but there can be no doubt that there is such a brood in this State, since on July 1 of the present year pupæ were found at Springfield, and at the present writing, July 8, many beetles are emerging.

FIG. 1. Different stages of the elm-leaf beetle: *a*, eggs; *b*, larvæ; *c*, adult; *e*, eggs enlarged; *f*, sculpture of eggs; *g*, larva enlarged; *h*, side view of greatly enlarged segment of larva; *i*, dorsal view of same; *j*, pupa enlarged; *k*, beetle enlarged; *l*, portion of wing-cover of beetle greatly enlarged. From Riley, report United States Department Agriculture, 1883.

FOOD PLANTS.

This insect feeds upon both the European and the American elm, naturally preferring the former. In many cases, notably at Northampton, where European elms stand in close proximity to American elms, the former are badly injured, while the latter are practically unharmed. Where the European elm is not available, however, the American species

is readily attacked and severely injured. At Groton, last summer, numbers of large American elms were so severely injured that they were as brown as if scorched by fire. At Springfield several American elms that were stripped three years in succession are now in a dying condition. Dr. Felt states that the Scotch elm also suffers seriously from the attacks of this insect.

Nature of the Damage. — The first injury to the tree is caused by the attack of beetles on the leaves. Later the larvæ destroy the epidermis, the leaves turn brown, die and fall, and the tree is left bare until a second crop of leaves is thrown out. Frequently these leaves are in turn destroyed by the later brood of larvæ. The effect upon the tree is shown by the gradual death of the smaller branches, and of the entire tree in cases of severe and continued stripping. City trees, through ignorant or careless treatment, commonly suffer from lack of food and water supply, due to the cutting off of roots to make room for curbings and water and gas mains. Such trees have but little reserve vitality, and are easy victims to damage by the beetle. The weakened condition of trees defoliated by the elm-leaf beetle invites or favors attack by other insects, notably borers, bark beetles and the elm-bark louse.

Natural Enemies.

Several species of predaceous beetles are known to attack this insect. In Massachusetts two species of soldier bugs (*Podisus serieventris* and *P. placidus*) are its most common enemies. These beneficial little bugs frequent the infested trees and prey upon the larvæ and pupæ.*

Remedies.

In combating the elm-leaf beetle the chief reliance should be placed upon the use of arsenical insecticides, and of these the most satisfactory is arsenate of lead, which should be used at the rate of five to ten pounds (actual arsenate of lead) to one hundred and fifty gallons of water. Its preparation and application are discussed on another page.

* At Squantum, July 12, a third species of predaceous bug (*Stiretrus anchorago*) was found feeding upon the larvæ of the elm-leaf beetle.

The first spraying should be in May or early in June, while the beetles are feeding. This treatment, as has been shown by Mr. C. L. Marlatt, is very efficacious, since, by destroying the mature beetles, egg-laying and the consequent development of larvæ are prevented. Later, when the larvæ have appeared and the main body of the foliage has developed, a second application should be made. This, if thorough, may suffice for the season, although in some cases a third spraying may be necessary for the second brood. In all cases the insecticide should be used in liberal quantities.

With rough-barked trees many of the larvæ pupate in the crevices on the trunk and even far up in the tree, hence scraping the bark is advisable. This will cause the larvæ to descend to the ground to pupate, where they will be found massed in great numbers at the base of the trees, under or along the bottom rails of fences near by, and in other convenient spots. In this stage they may be destroyed by kerosene emulsion applied to the trunks and to the ground beneath the trees.

Spraying Outfits. — For use in parks or cities, where large numbers of trees are to be sprayed, a power spraying outfit will be found the most satisfactory. This consists of a small engine with suitable pump, mounted on a substantial one-horse truck, which also carries the spraying tank and supplies. There are several styles of small engines suitable for this purpose, but the writer is of the opinion that gasoline engines are the most economical, as well as being cleaner and more easily attended. City Forester Gale of Springfield informs me that the gasoline engine used by him in spraying is operated at a cost for fuel of one cent per hour. The pump should supply at least two lines of hose, and should have a release valve or "blow-off" to save strain on lines of hose temporarily out of use. The tank should be cylindrical with adjustable hoops, so that shrinking of the staves may be taken up. Square or rectangular tanks are much less durable than cylindrical ones.

Several large hand outfits may be substituted for a power sprayer, and when this is desirable an outfit similar to those used by the gypsy moth committee is recommended. This is composed of a one-hundred-gallon tank, mounted on a

two-wheeled truck and containing a powerful pump placed within the tank (fig. 2).

A smaller spraying outfit may be prepared by mounting a suitable pump on a barrel or cask, the whole being fastened in a wagon or cart. Among other pumps used for this purpose the "Deming" pump is perhaps as satisfactory as any.

For use in spraying there is nothing better than the one-quarter-inch hose with improved couplings (fig. 3), in-

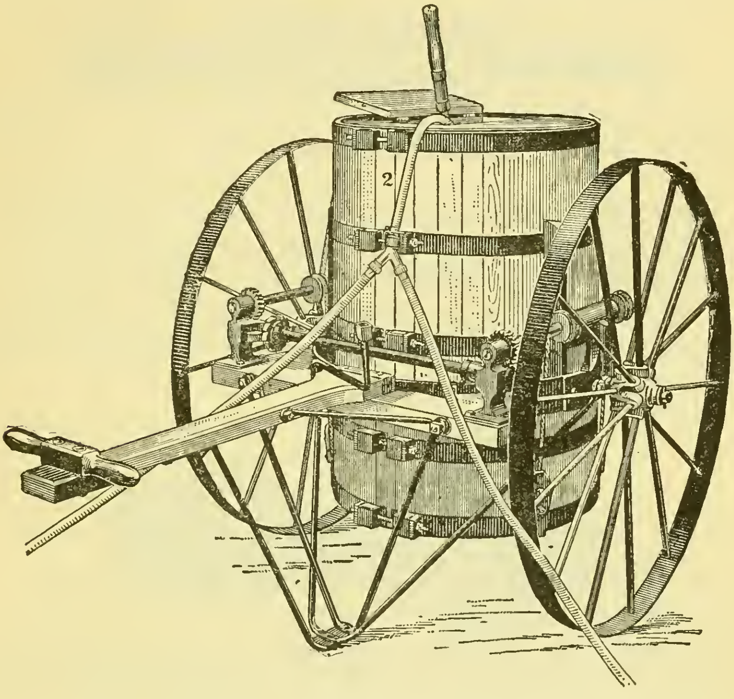


FIG. 2. Spraying outfit used in operations against the gypsy moth. From Forbush, report Massachusetts Board of Agriculture, 1898.

vented by Mr. E. C. Ware of the gypsy moth force. It is light, strong, and the couplings cannot be forced off. No feature of spraying operations is more exasperating or expensive than the frequent delays caused by the loosening and leaking of couplings. With the small hose and couplings figured herewith these factors are eliminated. For spray-poles use a one-quarter-inch gas pipe, ten feet long, encased in wood, with a coupling at one end for the hose and at the other for the nozzle.

In spraying operations against the elm-leaf beetle the end to be desired is the thorough covering of the foliage, *particularly the under surface*, with a mist-like spray. For this reason nozzles that throw a stream are undesirable, as well as being wasteful of the spraying mixture. In our work against the gypsy moth we have found the four-way modified cyclone nozzle (fig. 4) to give the most satisfactory spray. Other good nozzles are the vermorel and cyclone.

FIG. 3. One-quarter-inch hose with improved couplings. From Forbush, report Massachusetts Board of Agriculture, 1898.

It is not necessary to use glucose to cause arsenate of lead to adhere to the foliage. Experiments made under the direction of the gypsy moth committee have shown that no substantial gain is made by the use of glucose, a result that has been confirmed by the independent investigations of City Forester Gale at Springfield.

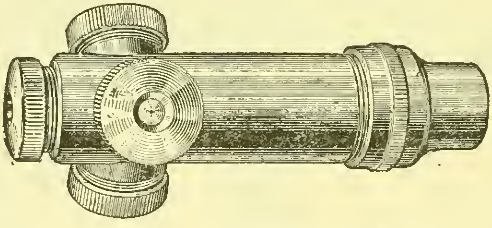


FIG. 4. Improved four-way nozzle. From Forbush, report Massachusetts Board of Agriculture, 1898.

Arsenate of Lead. — This insecticide is now generally used against the elm-leaf beetle, and possesses the merits of being harmless to the foliage and of adhering to it in an effective condition for a long period. It is prepared by mixing a solution of arsenate of soda with a solution of acetate or nitrate of lead, when arsenate of lead is formed as a curdy white precipitate. The following table, adapted from Smith,*

* For an excellent and comprehensive treatise on the preparation of arsenate of lead, see article by F. J. Smith in report of Massachusetts Board of Agriculture, 1897, pages 357–369.

shows the necessary amounts of the ingredients where acetate of lead is used: —

Arsenate of Lead desired.	Arsenate of Soda (65 Per Cent).		White Acetate of Lead.	
Lbs.	Lbs.	Oz.	Lbs.	Oz.
1	-	$9\frac{1}{2}$	1	5
3	1	$11\frac{1}{4}$	3	15
5	1	$13\frac{1}{3}$	6	9
10	5	$10\frac{5}{6}$	13	2

Using nitrate of lead, the following amounts of ingredients are necessary: —

Arsenate of Lead desired.	Arsenate of Soda (65 Per Cent).		Nitrate of Lead.	
Lbs.	Lbs.	Oz.	Lbs.	Oz
1	-	$10\frac{3}{4}$	1	$4\frac{1}{2}$
3	2	-	3	$13\frac{1}{2}$
5	3	$5\frac{1}{3}$	6	$6\frac{1}{2}$
10	6	$10\frac{2}{3}$	12	13

The use of fifty per cent arsenate of soda is not recommended when the sixty-five per cent can be purchased at a fair price, since the former product is generally adulterated with common salt. Where large quantities of arsenate of lead are to be prepared it will be advisable to buy as high grade commercial arsenate of soda as possible, and to have a chemist determine the amount of acetate or nitrate of lead required for use with it.

The quantity of arsenate of lead to be used as a standard charge for the spraying tank having been decided upon, the ingredients necessary to make this quantity are determined. It will be desirable to make two ballasts, equal in weight respectively to that of the arsenate of soda and the acetate or nitrate of lead, in each case plus the weight of the scoop on the balance scales used. These ballasts may be made of

glass jars filled with shot, and by their use the ingredients may be accurately weighed, when they should be placed in stout paper bags, each package of arsenate of soda being tied inside of the corresponding package of the lead salt. In this way compact, convenient packages of the insecticide may be rapidly prepared. When desired for use, the arsenate of soda should be dissolved in a wooden tub, the acetate of lead being dissolved in a separate tub. The two solutions are then poured into the spraying tank, and the arsenate of lead is ready for use. The ingredients should never be dissolved in metallic vessels.

It is a good plan to first test the formula used by mixing a trial lot of arsenate of lead and allowing it to settle in the mixing tub. A few drops of chromate of potash solution added to the clear liquid which separates above the arsenate of lead should cause the formation of a yellow precipitate. This indicates that an excess of soluble lead is present, and consequently that all the soluble arsenic has been neutralized. A firm of manufacturing chemists, located at Boston, has this year placed upon the market an excellent brand of arsenate of lead in paste form, thus saving the delay incident to the preparation of the insecticide.

Kerosene Emulsion. — This insecticide is prepared by dissolving one-fourth pound hard soap in two quarts hot water, and adding to the soapsuds thus formed one gallon kerosene oil. The whole is stirred or churned until cool, when a white, creamy emulsion is formed. This emulsion should be diluted with nine parts of water. Kerosene emulsion kills by contact, and is a valuable agent for killing the larvæ and pupæ of the elm-leaf beetle clustered in the bark or in masses on the ground under the infested trees.

Useless Measures.

In cases of extensive injury by the elm-leaf beetle, individuals often spend in useless channels a large amount of energy which intelligently applied would be productive of good results. Among the more common mistakes are: —

Tar Bands. — These serve to prevent damage by the canker worm by intercepting the wingless female moth on her way up the tree to deposit eggs. The female elm-leaf

beetle *flies* into the tree, hence these bands are valueless against this insect.

Cotton Bands. — The considerations mentioned above apply to cotton bands.

Sulphur Plugs. — Nothing better illustrates the credulity of mankind than that sons of Belial still find victims who are willing to pay for the plugging of trees with sulphur to ward off insect damage. It is needless to say that this treatment is a swindle pure and simple, and that money spent for this purpose is but charity given to unworthy objects.

Kerosene. — Valuable elms are frequently killed by the use of pure kerosene on the trunks as a means of destroying the pupæ. The oil accumulates at the base of the tree, and, where used in quantities, kills the roots. By substituting kerosene emulsion for kerosene all danger will be avoided.

Street Sweepings. — The sweeping up and carting away of the masses of pupæ and larvæ along with the other rubbish of the streets is not an uncommon sight in infested cities. In a case observed by the writer in July, 1898, quarts of the pupæ were carefully swept up in a public square and carted to the city dump. In all such cases the sweepings should be burned, or treated with crude petroleum or kerosene emulsion.

General Considerations.

Outbreaks of the elm-leaf beetle are best dealt with by municipalities through the city forester, the park or the street department. When feeding upon park and street trees, the pest attacks the common property of the citizens, and all may properly share in the expense of combating it. With suitable apparatus and insecticides, and competent men to make use of them, the elm-leaf beetle can be kept under control and the infested trees preserved from serious injury. The general plan adopted by the city of Springfield is a most excellent one. Liberal appropriations are made by the city, to be expended under the direction of the city forester, a man of exceptional fitness for the place. Two power and a number of smaller hand spraying outfits have been provided, also a large stock of ingredients for making arsenate of lead. A suitable force of men is engaged, and spraying operations

are begun as soon as the beetles begin to feed and lay in the spring. Spraying is continued until into July, or as long as injury by the larvæ continues. Infested trees on private estates are sprayed by the city's employees, and the expense charged to the owner. By this method the damage by the beetle is reduced to a minimum and the preservation of the elms secured. A similar method on a somewhat smaller scale is followed at Northampton, with most excellent results.

Damage by the elm-leaf beetle emphasizes the desirability of planting a *variety* of trees in parks and along streets, in order to escape those insects which are confined to a few food plants. Large numbers of a single species of tree, planted thickly, give the insects attacking that species an excellent opportunity to multiply. By planting a great variety of trees, taking care that only small numbers of a single species are placed near together, a large amount of future damage by insects may be prevented. In every case the European elm should be planted sparingly, if at all.

SUGGESTIONS FOR THE USE OF BARNYARD MANURE.

BY CHAS. WELLINGTON, PH.D., PROFESSOR OF CHEMISTRY, MASSACHUSETTS AGRICULTURAL COLLEGE.

In these latter days of human progress every department of activity has become complex, and is with every day becoming more so. That most important and fundamental of all callings, *farming*, offers no exception here. Of all the factors that enter into his business, *over which he has control*, barnyard manure is at once the most valuable and the most abused by the farmer. It is the most valuable, because, although a waste product of all general and stock farming, it nevertheless contains the three most costly elements of plant food (nitrogen, potash and phosphoric acid), and, what is more important, it is the only *entire* all-round fertilizer known. It is the most abused, because, the farmer, either knowingly or unknowingly, handles it wastefully, and largely allows it to become valueless before reaching the growing crop.

Professor Roberts allows $250, at least, as the value of the manure for seven months on a small farm with four horses, twenty cows, fifty sheep and ten pigs. By the present wasteful management, one-third of this, $83.33, is on the average lost to the farmer. The annual value of this material for the United States is placed at $2,071,400,000. One-third, or $690,466,666, is *lost annually to the farmers of this country*. Could any other national business be carried on with such a loss and be made to pay? This is *only one* of the much-talked-of "*wastes of the farm*," and yet this alone furnishes abundant proof that *farming does pay*. For that large number of so-called "farmers" *who knowingly* waste their barnyard manure there is *positively* no help. They also waste at every point; they are not *business men*, and therefore they *are not farmers*. For *true farmers* who

are at their business for what there is in it, and for all that hard, persistent thinking and careful practice can make it, who *unknowingly* waste barnyard manure, here is an opportunity to make a saving equal to the difference between success and failure; for that, frequently, equals the value of the manure wasted. This is to be secured by following the practice approved by the results of hundreds of experiments made by careful workers. In the succeeding pages these results are summarized. We will consider, briefly: —

I. What barnyard manure is made of.
II. How it compares with *other* manures.
III. How to make it.
IV. How to use it.

I. — What Barnyard Manure is made of.

Barnyard manure consists of the dung and urine of horses, cows, pigs, sheep and winged animals, sometimes of human beings, and "litter" mixed in all imaginable proportions with more or less of "fixers" and preservatives. The domestic animals feed chiefly on vegetable material. This is taken partly from the field direct, in the form of grain, hay, straw, roots, etc., and partly as by-products from various factories, like bran, gluten meal, oil cakes, brewers' grains, pomace, etc. When any of this material is fed, about one-half of its organic portion, containing the nitrogen, is digested, and serves as food for the animal. It is eventually either dissipated into the air through the breath, in the form of carbonic acid gas and water, or is deposited as muscle and fat, hair, wool or milk, or is transformed into work in the case of draught animals. The other half, the undigested portion, goes through the organism, and, while most of it falls as dung, a considerable portion of the *nitrogen* passes through the kidneys *into the urine*. The mineral or ash constituents of the food, including *potash* and *phosphoric acid*, also go partly into the digested portion, partly into the dung and partly into the urine. The dung and urine of work animals contains all of the nitrogen, potash and phosphoric acid taken in the food; while in young, fattening or milk animals, portions of these go into bone, flesh and milk.

This mixture of dung and urine is collected in tanks for several months in some countries, as, for example, in Holland and Switzerland, without further admixture. It is then called *Gulle.* It undergoes a peculiar fermentation, and is spread as a liquid over the fields. In most countries, however, as with us, the better way is followed of using litter, for the double purpose of making confined animals clean and comfortable and of absorbing the liquid portion. This litter consists of almost any light, dry, waste material, such as straw, leaves, sawdust, land plaster or dry earth.

Dung and Urine. — The value of these depends on the food, age, breed, condition and work of the animal. The richer the food, the richer the excreta; the older the animal, the richer the excreta. A working animal will yield more value in excreta than one which is fattening.

Dung. — This consists of the undigested and undissolved portion of the food. It is much poorer in plant food than the *urine*, which has more manurial value, and should be most *carefully saved and used.* It consists of substances which have been digested, and which are therefore very quickly assimilated by plants.

The following table (from Wolff) shows the percentages of nitrogen in the original food which go into the dung and urine of the respective animals: —

	Horse.	Sheep.	Ox.	Cow.	Average.
Dung (per cent), . .	32.4	46.7	33.9	47.5	40.1
Urine (per cent), . .	60.7	42.3	54.8	31.0	47.2

Phosphoric acid is practically wanting in horse and cow urine; sheep urine has somewhat more. The largest amount is in pig urine, but even there it is present only in traces. Sheep urine is the most valuable, next comes horse urine, then cow urine, and last of all pig urine, counting *all the elements* together.

Litter. — The qualities which should be looked for in a good litter are: —

1. A conservative action on the fermenting dung and urine.
2. Rapidity of disintegration.
3. A high water absorbing and retaining power.
4. Cleanliness.
5. Relatively high contents of nitrogen, potash and phosphoric acid.
6. Low market value.

The following list contains most of the materials commonly used, and, as to the above qualities 1, 2, 3 and 5, it gives them in the order of their values, beginning with peat moss, the highest in value: —

Peat moss.	Winter rye straw.
Peat.	Barley straw.
Dry loam.	Wheat straw.
Dry muck.	Sawdust.
Summer rye straw.	Dry leaves.
Oat straw.	

The reason for giving preference to peat moss and the three following materials is because they possess the first quality in the highest degree. This will be considered further under the head of "How to make barnyard manure." But when cleanliness is considered, the straws rank first, and peat, muck and loam come last. Sawdust and leaves decompose very slowly, and leaves especially have but little nitrogen, potash or phosphoric acid left in them. Unfortunately, all the good qualities are not possessed by any one material. Peat, etc., have the highest conservative power, but they are not cleanly. The clean straws, however, are the poorest in conservative power, because they support the bacteria which do harm. (See "How to make barnyard manure.")

Although high percentages of nitrogen, potash and phosphoric acid are valuable in litter, the best of these materials contain only small amounts, and this quality is outranked by those placed before it in the above list in giving value to barnyard manure.

"*Fixers.*" — When manure is stored at any depth over a few inches, it ferments, and large quantities of the most

valuable nitrogen become soluble and volatile in the form of ammonia, which is a gas. This gas is well known as "hartshorn," and is easily recognized by its strong odor. It forms very rapidly in the presence of a limited amount of moisture and a somewhat elevated temperature. Urine is its principal source, and next to that comes horse dung.

It is very important that *all* this gaseous form of nitrogen be saved, and whenever its odor is detected, means should immediately be taken to "fix" or absorb it. No space containing manure should be allowed to smell of ammonia. Substances used for this purpose are: —

Hydrochloric acid, which fumes strongly.

Sulphuric acid, which does not fume, but corrodes everything it touches, *e.g.*, the hoofs of horses and cattle.

Neither of the above should be employed.

Green copperas is good, but it is also slightly corrosive, and often injurious to crops.

Gypsum or land plaster is excellent.

Sulfate of magnesia is the same. It sometimes combines with and holds the soluble phosphoric acid.

These materials are sprinkled daily over the floor and manure.

Preservatives. — While the foregoing substances retain the ammonia, they do not *prevent* fermentation. Sometimes a farmer wishes to accomplish both of these ends. The following substances, when mixed with the manure, act in this *double way*: —

Sulfate of magnesia, or kieserite.

Double sulfate of potash and magnesia.

Carnallite and kainite, containing chloride of potash, salt, sulfate of magnesia and chloride of magnesia.

When these are used, account is taken of the addition of potash to the manure.

Charcoal and peat are also good fixers, and to an extent preservatives.

The finished manure from different animals shows very different qualities: —

Horse manure is the most uniform of all, because the horse's food is the most uniform, and generally of the same kind. It is a rich manure, and ferments quickly, producing

much heat. It is known as a *hot* manure. There are 9.9 pounds of dry excrement, with .26 pound of nitrogen, produced daily by each animal. From 4 to 6 pounds of straw are used daily.

Sheep manure is, weight for weight, the most valuable of all. It contains more nitrogen and phosphoric acid, but less potash, than horse manure. It does not decompose so readily, and is next to horse manure as a heater. There is .97 pound of dry matter, having .04 pound of nitrogen, produced daily per animal. Three-fifths of a pound of litter is used daily.

Pig manure is generally rich, does not develop much heat, and is called *cold*. It should always be mixed with other manure. There are 1.5 pounds of dry matter, with .05 pound of nitrogen, produced daily per animal. From 4 to 8 pounds of straw daily per animal are recommended.

Cow manure is very much less constant in composition than that of the horse. It decomposes slowly, with the evolution of little heat. It is the poorest in plant food of any farm manure. There are 9.92 pounds of dry matter, having .26 pound of nitrogen, produced daily per animal. From 6 to 10 pounds of straw daily per animal are used.

Poultry manure resembles guano in composition, but is less valuable. Its nitrogen is in a very assimilable form. It ferments rapidly.

Night soil is of high value, if *immediately* and regularly composted, otherwise it loses its good qualities.

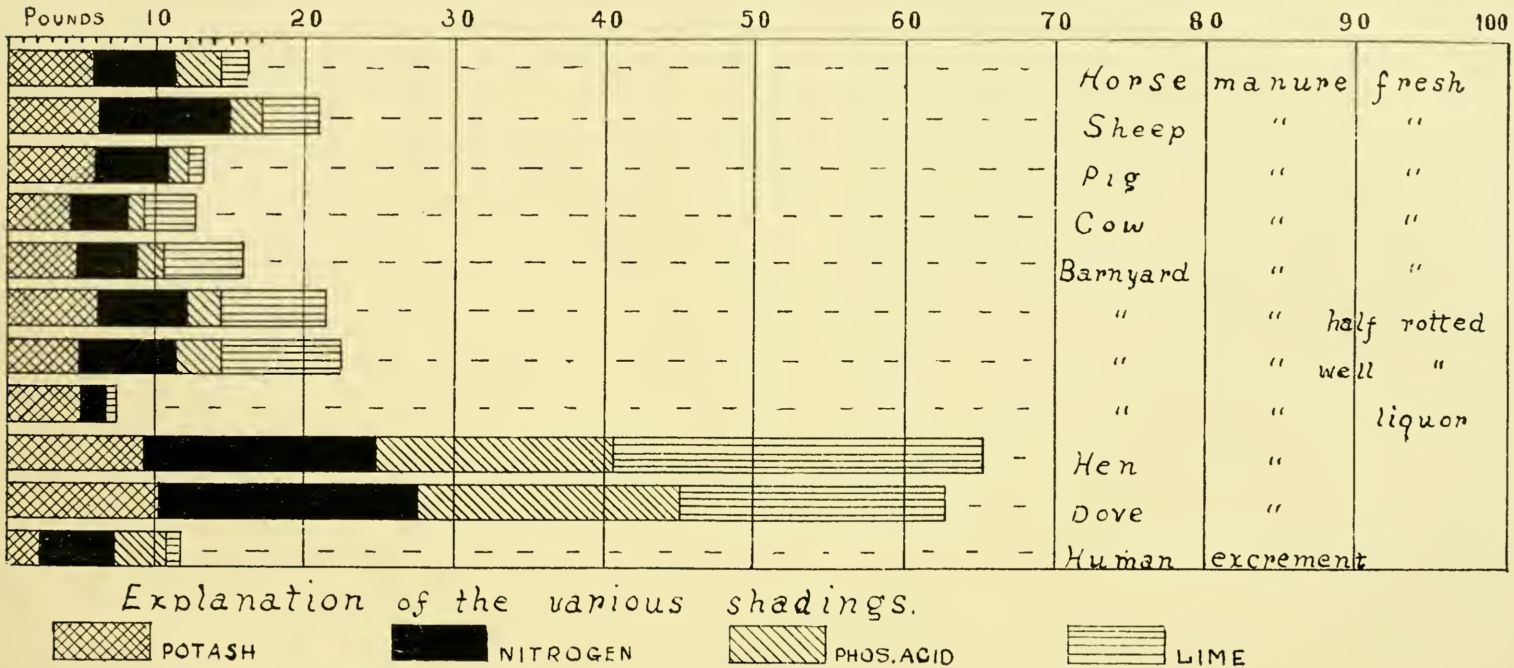
The shaded lines on the plate opposite show the relative amounts of the elements of plant food in several of these products.

II.— How Barnyard Manure compares with Other Manures.

In judging the value of any manure or "fertilizer," * six points must be borne in mind, namely: the percentages of nitrogen, potash, phosphoric acid and lime; fifth, the availabilities of each; and, sixth, the mechanical effect which the manure has on the soil. With reference to these, let us

* In this paper, "manure" and "fertilizer" mean the same thing.

1000 pounds of the various MANURES contain POTASH, NITROGEN, PHOS ACID, and LIME, as follows:



examine the following table, which classifies the principal kinds of manures: —

Manures,	Entire,		Barnyard manure.	
			Other wastes,	Oil cake. Malt germs. Wash waters. Sewage, etc.
			Composts,	Various.
	Partial,	Mixed,		Human excrements. Guano. Various ashes.
		Concentrated,	Nitrogen,	Nitrate of soda. Sulfate of ammouia. Ground meat. Ground fish, etc.
			Potash,	Muriate of potash. Sulfate of potash, etc.
			Phosphoric acid,	Raw phosphates. Superphosphates.
			Lime,	Various lime wastes.

While many valuable manurial substances are mentioned in the column at the right, only the first, barnyard manure, contains all the elements of fertility, and at the same time the power to improve the soil mechanically. This is why it is called *the* "entire" manure.

Barnyard manure deserves such a name more than any other manure, but farmers are often sadly misled by such a designation; for it is supposed that, if this "entire" manure is applied to the fields, *no other* manuring can be necessary. This designation *means simply* that every one of the requirements of a manure is found in barnyard manure, to a *certain degree.* But this degree is unfortunately very small except in one particular. It brings into the soil a large quantity of organic matter, which forms *humus.* This increases the power of the soil to attract and retain moisture, makes it more porous, promoting aeration and fermentation and the bringing of all plant food into forms available for the crops. For clayey or heavy soils it is of greatest value, and of least on light and porous soils. Herein lies the chief value of barnyard manure.

The analysis of a *good* half-rotted barnyard manure gives: —

	Per Cent.	Pounds per Ton.
Nitrogen,	.606	12.12
Potash,	.672	13.44
Phosphoric acid,	.315	6.30

That is to say, an application of 2,000 pounds of barnyard manure brings into the soil practically only 12 pounds of nitrogen, 13.40 of potash and 6.3 phosphoric acid, — very small amounts. An average cropping is found to remove from one acre of land, in one year, 50.5 pounds nitrogen, 41.6 pounds potash, 19.1 pounds phosphoric acid.

To return these amounts to the land would require 8,333 pounds of barnyard manure for the nitrogen, 6,332 pounds of barnyard manure for the potash, 6,064 pounds of barnyard manure for the phosphoric acid.

These figures show that barnyard manure contains too little nitrogen in proportion to its potash and phosphoric acid, and this has been proven over and over again. Of all plant food, the soil lacks and needs most *nitrogen.*

As to the proportion of potash and phosphoric acid, they are shown by the last two weights given to be replaced in the soil by nearly the same weight of barnyard manure. This might suit in some soils, but in very many it would not. In England they find this proportional amount of phosphoric acid too little, while in Massachusetts the proportion of potash is too little.

Barnyard manure excels, therefore : —

1. Because it brings into the land a large amount of the much-needed humus.

2. Because it contains some of every kind of plant food. Nothing can take the place of barnyard manure.

It is deficient : —

1. In all the three costly elements of plant food.
2. Especially in nitrogen.
3. For Massachusetts, in potash.

It must therefore be re-enforced by all three elements, *especially* by nitrogen and potash.

III. — How to make Barnyard Manure.

Barnyard manure should be made with reference to the preceding and the following statements. *It should be made under cover*, to prevent the addition of an excess of rain water. It should be made in a room with water-tight floor and sides, in order to prevent drainage, the drainings being the most valuable part. It should not be stored under or over stock, because of its unhealthy gases.

Apparently the most economical arrangement which meets these conditions is a room placed in the rear of a horse or cow stable, running parallel to the latter and separated from it by a tight wall provided with slide windows, through which the manure may be thrown from the manure trough behind the animals. This room would then probably be long enough, and just wide enough to hold the accumulations of the season. A better, though more expensive way, is to provide a square or round room, to which the barnyard manure may be carried in a wheel-barrow or cart.

One of the litters before mentioned should be provided daily, the amount to be used being calculated according to the amount of liquid present. With horses, allowing $6\frac{1}{3}$ pounds of dry dung and $22\frac{3}{4}$ pounds (about 3 gallons) of urine per day and per animal, the proper amount of straw would be from 4 to 6 pounds daily. This would give from $5\frac{1}{4}$ to $5\frac{1}{2}$ tons per horse, annually. With cows, the Germans calculate the dry substance in the food, and take litter equal to one-third of that weight. A somewhat extended practice is to shake out the clean straw from the horse manure in the morning, allow it to dry in the open air and then use it over again. This allows of making a more comfortable bed for the animals without admixing an excess of litter. If properly done, the method is not a bad one, but if it increases the evaporation of fermented urine, it should not be followed.

The floor should be sprinkled daily with a very thin coat of one of the fixers, land plaster being one of the best. If it is desired to hinder fermentation, a *preservative* may be sprinkled on the manure pile daily.

As has been seen, the manures from different animals differ considerably in their qualities. For special purposes

it is often advisable to keep these apart. If a "hot" manure for forcing is desired, then horse manure should be made alone, or, at the most, mixed only with sheep manure. Poultry manure acts quickly, its constituents, especially the nitrogen, being in a very assimilable form. Fixers should be spread in the poultry yard, and the material mixed with peat or muck. This gives a very valuable product for *truck*. Manure for general purposes is best when made of an intimate mixture of the dung and the urine from all the animals. Careful mixing when the manure is thrown onto the pile is of great importance. It aids in preventing "fire-fang" in the hot horse dung, and promotes fermentation in the *cold* varieties. Leaching should be prevented as much as possible. If it occurs, and it generally does, the leached liquor should be thrown onto the heap as evenly as possible, by means of a scoop or a pump with a long adjustable spout. This precaution is not merely to save the liquor, but also to promote proper fermentation.

In case of a large proportion of hot horse manure, this liquor may not be sufficient to maintain a regular fermentation. The manure may "fire-fang" and smoke. In that case it will be necessary to sprinkle with water from day to day until such action ceases. This wetting, whether with the leachings or with water, should be done with the most possible regularity. After the manure is placed on the pile, it should not be disturbed, but it should be stamped and packed away from the air. These steps are necessary to prevent the loss of potash and phosphoric acid, and especially of nitrogen, both by the formation and evaporation of ammonia and the separation and escape of nitrogen gas itself.

As the making of barnyard manure is principally a matter of fermentation, special study should be given to this combination of changes. When a pile of manure lies for months without disturbance, it grows smaller and smaller; it is comparatively dry; the straw has disappeared and become "humus;" the whole mixture is more uniform in color and character,— it is half rotted. Then, after a few more months, the bulk has grown very much smaller, and a black, moist, slimy, homogenous mass results; the manure is well rotted.

Chemists have long known in a general way what changes

take place during this process, but not until recently has anything like a satisfactory explanation of them been made. This explanation depends upon the discovery of existence and actions, in the manure, of three classes of very small microscopic organisms called bacteria. They are responsible, not wholly, but chiefly, for the changes mentioned. Let us note here just what chemical materials are in the manure at the beginning, and what they are changed into.

The fresh manure contains mineral substances like potash and phosphates, and also organic material of two kinds, namely: the nitrogenous, found in the liquid manure and to some extent in the solid; and the non-nitrogenous, which largely makes up the straw, leaves, sawdust and solid excrement. It is just these two kinds of organic constituents, and what they become, which concern us now.

In those portions of the manure which are accessible to the air one class of bacteria live and breed in enormous numbers. They feed on the oxygen of the air and the nitrogenous portions of the manure, and in their excrements give off large quantities of nitrates, the latter being the direct products of the oxidation of nitrogenous organic matter anywhere, whether in the bodies of these bacteria or not. These nitrates, being very soluble in water, drain down into the interior of the manure heap, just as they drain through the soil; but, instead of all going off in the drainage water and becoming lost, as they often do in the soil, they are chiefly lost by an entirely different process.

In the interior of the heap, shut away from the air, these nitrates fall prey to another class of bacteria, known as "nitrate destroyers." They completely undo the work of the other bacteria, or "nitrate formers." The "nitrate destroyers" live on the non-nitrogenous constituents of the straw and leaves and the oxygen of the nitrates. This liberates the nitrogen in the form of gas, which escapes into the air and is lost to the farmer. The process also consumes the non-nitrogenous portion, which is chiefly the remainder of the litter. It is formed into water and carbonic acid gas, which escape into the air and thus diminish the bulk of the pile. While the "nitrate formers" live near the surface of the manure and require air for their work, the "nitrate de-

stroyers" live away from the air and do not need it. They are dependent, however, on food of a certain kind, and must have plenty of it, otherwise they become inactive and can do no damage, though millions of them may exist in the interior of the manure pile. One of their principal foods, the non-nitrogenous material of the litter, they cannot use as food until it has been made soluble by a third class of bacteria, which causes the rotting of the litter. Nitrates are also indispensable for their nourishment. If, therefore, they are deprived of either one of these constituents of their diet, they either die or at least become harmless.

The work of the "nitrate formers" is beneficial; it converts organic nitrogen into nitrate, a most available form of plant food. Half-rotted manure contains nitrogen largely in this form. The work of "nitrate destroyers" is destructive; it removes the soluble nitrates from the manure; it converts half-rotted manure into well-rotted manure. In this way the different effects produced by manure in the three different conditions are explained. The nitrogen in fresh manure is largely organic, and not immediately available; it therefore has a slower and less effect than half-rotted manure. The nitrogen in half-rotted manure is largely in the form of nitrates, and this is available. The nitrogen in well-rotted manure has all been converted into nitrates also, and was once available, but has subsequently been lost in the air. This is why the well-rotted condition is the least valuable of the three.

Of the three common conditions of barnyard manure, half-rotted manure is the most valuable and well-rotted manure the least, because of their relative amounts of nitrates.

Manure should be kept packed away from the air as tightly as possible, and, if rotted, should be plowed under just before planting, otherwise, several months before that time.

The more litter used in the manure, the greater liability to loss of nitrogen.

The use of bedding material free from decomposable organic matter is a means of protection against loss of nitrogen.

IV. — How to use Barnyard Manure.

We have now reached the difficult part of the matter. The *most* economical use of barnyard manure is seldom made, largely because of our ignorance of the exact needs of the plant in the particular soil used; some general rules, however, may be laid down.

The farmer should strive to place the manure at the disposition of the growing crop just at that moment when the most nitrate has been formed and before any has been destroyed. The most favorable conditions are obtained when fresh manure is packed as tightly as possible away from the air, kept in that condition until half-rotted, and then plowed under just before planting or sowing. Under these circumstances, although the third class of bacteria have in the rotting of the litter made soluble food of one kind for the "nitrate destroyers," the latter have been deprived of their necessary food, the nitrates, for none could be formed in the tightly packed mass, and they have remained harmless. But the heap has become half rotted, even without them. After the manure is plowed in, the "nitrogen formers," now having plenty of air, rapidly produce nitrates which are beyond the reach of the destroyers; for by this time all their soluble non-nitrogenous food has been decomposed and has gone into the air, leaving them to die. The growing plants in the meantime absorb the nitrates.

If fresh manure is plowed in directly before seeding, a poor result is obtained, for the nitrates are not formed until after the plants have passed their growing period, and they consequently starve. As might be supposed, winter crops fare better with this procedure than spring crops. By plowing in fresh manure several months before seeding a much better result is obtained, because the nitrates are on hand and are being formed at the growing period of the crops. Experience has abundantly proven that it is better to plow manure into the soil and allow it to lie there rather than in the pile. Whether it is better to leave manure spread on the surface of the land rather than to plow it in or leave in pile, depends chiefly on the amount of loss caused by surface drainage. This may be small, but, if the ground is frozen,

the surface inclined and the manure half rotted or more, the loss will be considerable. The nitrate-destroying bacteria are of several species, and have thus far been found in straw and various other litter, in soils and in the dung of herbivorous animals. They have not been found in human excrement or that of the carnivora or birds.

When barnyard manures are made with bedding devoid of much decomposable organic matter, the nitrate-destroying bacteria cannot work in them, for they cannot obtain the soluble organic food necessary for their sustenance. Anything like sand, loam or turf, therefore, may be used for bedding without incurring the disadvantage due to straw litters.

Wherever much nitrate of soda is applied to crops, there is produced a relatively large yield of straw, which in turn leads to a large use of this material as litter. This excessive quantity of straw in the manure materially lessens its value in the manner described.

Manure is brought from the storage to its place in the field by four different methods: —

1. It is unloaded in the field into large heaps, and, after remaining there a convenient time, is spread over the land and plowed in.

2. It is distributed in small heaps, and then treated as before.

3. It is spread evenly over the land, and allowed to lie a long time.

4. It is evenly spread and immediately plowed under.

Unquestionably the last method is the best of all, the first is the second best and the third is the poorest way of all. The reasons for this are very apparent, when it is remembered that the half rotted manure should be placed at the disposition of the growing plant at the earliest moment, with the least possible opportunity of loss by evaporation or drainage. It should be evenly distributed over the land. This is impossible to attain, when it is first deposited in heaps and allowed to drain into the patches of soil under the heaps before being spread.

As to the amount of barnyard manure to be applied to the land for various purposes, a general rule may be mentioned

here which should apply in all manuring, — only apply as much as seems to be necessary for present purposes. The old method of stocking land with barnyard manure for future use is a waste.

Special formulas for various crops, either alone or with other manures, may be found in the bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College. These can be easily obtained by application to the director at Amherst.

BIRDS AS DESTROYERS OF HAIRY CATERPILLARS.

BY E. H. FORBUSH, ORNITHOLOGIST TO THE BOARD.

One spring day, long years ago, a vireo sang in a sunny, swampy thicket. Suddenly the bird ceased its song, leaned forward, ran along the limb, picked a large caterpillar from a twig, pecked it a little, swallowed it and resumed its song. A small boy, a witness of the act, followed the bird closely, and saw that during each intermission of the song it was occupied either in catching caterpillars or other insects on the twigs and leaves, or in pursuing flying insects through the air.

Previous to that day birds had interested the writer principally because of their beauty and song, but this incident opened a new field for study, the pursuit of which has since convinced him that birds as a class excel all other animals as destroyers of those insects which feed upon vegetation, and that the species of plant-feeding insects which escape decimation by birds, at one time or another, are very few as compared to the total number of such species in existence.

In such research as the writer has been able to make in agricultural, ornithological and entomological literature it has become noticeable that certain insects are supposed by many writers to be protected by prickly hairs or spines from the attacks of birds. This astonishing error, for which there is really very little excuse, has been repeated, in one form or another, by writer after writer during the present century, and is still persisted in. No less an authority than the late Prof. C. V. Riley, for many years entomologist to the United States Department of Agriculture, has assisted in the promulgation of this belief. The most positive statements have been made to the effect that birds do not eat hairy caterpillars, although here and there an exception to the rule is named.

Among the earliest of these statements now at hand is one from a writer in the "Annales de l'Institut Horticole de Fromont," vol. 5, p. 311, published in Paris in 1833. In discussing the opinion promulgated by the Natural History Society of Gorlitz, that the diminution of fruits is on account of the diminution of birds, he places the caterpillar of the gypsy moth at the head of the list of injurious caterpillars, saying that "above all it is very essential that it be destroyed." He says further that, as these caterpillars are armed with long hairs, the birds guard well against bringing them to their young, and that in twenty years of observation he has not seen a single example. He also states that these insects when in the chrysalis are not sought by birds.

Statements like the above have been received without question, and the inferences and conclusions drawn by the earlier writers appear to have been accepted and promulgated by others. In recent years, however, more accurate knowledge seems to have been gained by a few observers at home and abroad in regard to this matter. The ornithologists of our national Department of Agriculture have added much to our knowledge of the subject.

The purpose of the present article is to furnish conclusive evidence that the hairs with which some caterpillars are armed are not a sufficient protection to guard them from the attacks of birds, many of which eat quantities of them and some also feed them to their young. It is also intended to show that many birds feed upon these insects later in the chrysalis or in the imago.

Those species of birds which feed upon hairy caterpillars are among the best friends of the farmer and horticulturist, in so far as they prove destructive to these insects, many of which are among the worst enemies of farmers and fruit growers.

When one attempts to disprove a theory which has been widely accepted for many years his readers are naturally inclined to be skeptical as to his conclusions, and to question the accuracy of the observations on which such conclusions are based. Therefore, a brief description of the methods used and a statement of some of the results obtained will be necessary here.

During the progress of the work on the gypsy moth by the State Board of Agriculture in Massachusetts more than a thousand men have been employed, among whom there are, or have been, many who know the common birds. Some of these men are keen-eyed observers. In the early history of the work, when it was seen that birds were feeding on the gypsy moth caterpillars, all those men employed who knew birds were requested to watch the birds and report the results of their observations. There were eleven such observers on the force at that time. Others have joined the force from time to time, until the number whose experiences have been recorded has been increased to thirty-eight. Some of these observers have seen birds feeding on the caterpillars of the gypsy moth for only one season, others have been in the employ of the Board for six, seven or eight years, and have made observations during each year. The conditions have been such that most of the birds could be observed within a few feet or a few yards. Those which could not be so readily approached were watched with the aid of good field or opera glasses, and where there appeared to be doubt birds were shot and the contents of their stomachs carefully analyzed.

Much was learned by experience in the earlier observations which has been turned to good account in conducting those made during the last three years. The value of such observations may be questioned by those who rely solely upon the examination of the stomach contents to determine the food of birds. But for the purpose for which these observations are made they are, if skilfully conducted, quite as serviceable as stomach examinations. In fact, one must supplement the other.

Were one to follow the birds about through the fields and woods no doubt some interesting facts might be learned in regard to their food, but it is not in this way that a series of accurate observations can be made. Birds are attracted to localities where insects are plentiful, preferring often to go some distance to such localities, where food is abundant and readily obtained, rather than to search for less abundant species near their nesting places. For our purpose, then, the method pursued is to find an outbreak of hairy cater-

pillars situated in a locality where many species of birds are likely to find it. The observer first makes sure as to the kind of insects to be found upon the trees or plants to be watched. He then conceals himself near the insects whose destruction he wishes to observe and watches the birds which come there to feed.

When this method is followed methodically by trustworthy, painstaking observers, and when results obtained by different observers, working independently, agree in the main, there can be no reasonable doubt as to the value of such observations. When the caterpillars are small, certain marked branches are chosen for observation, or certain nests, webs or tents are marked and watched at close range. One observer has even counted the number of caterpillars on a branch, watched the birds feed upon them and then counted the number left alive.

The results of the earlier observations were published in the report on the gypsy moth issued by the State Board of Agriculture in 1896.* It was then proved conclusively that thirty-eight species of birds were destroying the gypsy moth in one or more of its forms, and thirty-one of these were feeding on the caterpillars. Since that time several birds have been added to the list, and much more has been learned as to the comparative usefulness in this respect of several species.

The discovery of another introduced pest, the brown-tail moth (*Euproctis chrysorrhœa*), in Massachusetts in 1897, has stimulated further observation, and incidentally the feeding of birds on other hairy caterpillars has been noticed.

It is not the intention of the writer now to republish the result of the observations given in the report on the gypsy moth in 1896, but to place before the reader some facts observed that year and since. From the mass of observations on the food of birds a part has been selected of those which refer to the two introduced European species — the gypsy moth (*Porthetria dispar*) and the brown-tail moth (*Euproctis chrysorrhœa*) — and two common American pests, — the tent caterpillar (*Clisiocampa americana*) and the forest tent caterpillar (*C. sylvatica*). In these four species we

* "The Gypsy Moth," Forbush-Fernald, 1896.

have typical examples of genera the larvæ of which have been considered especially distasteful to birds on account of the hairs with which they are covered. The caterpillars of the brown-tail moth would appear to be a particularly disagreeable morsel to swallow. They are not only furnished with long, bristly hairs, but the hinder segments of their bodies are also supplied with minute, shorter hairs, which are barbed, somewhat like the quills of the porcupine. These hairs produce very disagreeable consequences when brought in contact with the human skin, into which they work their way and there become the source of a serious and long-continued irritation.* Many people in the district infested by the brown-tail moth have been seriously inconvenienced by this cause, and the services of physicians in the region infested have been widely sought for a remedy. The irritation resembles that caused by poison ivy, and no infallible cure has yet been found. One would think that a bird which had inadvertently swallowed one of these creatures would not care to repeat the experiment; but the observations of Mr. F. H. Mosher, a very careful observer, show that as many species of birds feed on the brown-tail caterpillar as upon the gypsy caterpillar, and some species eat quantities of the former. Some of the hairs of the gypsy caterpillar possess an irritating property, so that the sensation produced by them, when pressed against any tender portion of the human skin, is similar to that produced by nettles. The hairs on the tent caterpillar do not seem to possess either of these properties. But even these larvæ do not appear a tempting morsel, thickly covered as they are with long hairs. The forest tent caterpillar also is supplied with hairs sufficient to secure it immunity from the attacks of birds, if, indeed, such hairs constitute any protection whatever.

The Number of Hairy Caterpillars destroyed by Birds.

In order to get a definite idea of the comparative usefulness of the different species of birds in destroying hairy caterpillars, I have asked Mr. Mosher to count the number of caterpillars each bird was actually seen to eat during the time occupied in some of its visits to trees infested by cater-

* Proc. 10th Ann. Meeting Assn. of Ec. Ents., Bul. 17, p. 27, Prof. C. H. Fernald.

pillars. As examples showing the capacity of birds' stomachs for this kind of food, a few of his notes are given in brief below. In most cases it was impossible to count all the caterpillars eaten by a bird during its visit, for it was likely to be partially hidden from the observer a part of the time by twigs or leaves. The results given show only the number of caterpillars each bird was actually seen to eat. The observer in many instances notes that the bird must have eaten many more, as it was almost continually eating during its visit.

To prepare the reader for the somewhat startling facts which follow, it is necessary to consider some of the physiological characteristics of the bird. Birds as a class are among the most highly organized of vertebrate animals. In this class we find the extreme of activity and the highest temperature of the blood. Their remarkable activity, especially in flight, causes a tremendous waste of tissue. To supply the waste caused by this great expenditure of nervous energy a large quantity of food is required. Nature has made ample provision for the digestion and assimilation of this great quantity of food, supplying the bird with a remarkably perfect digestive apparatus, the action of which is very rapid. The writer has recorded elsewhere the results of experiments with two crows, which show that the food passes through the entire digestive tract in about one and one-half hours, and it is known that digestion is much more rapid in some of the smaller insect-eating birds. The amount of food required by the crow is given by Mr. E. A. Samuels as eight ounces per day. In reading what follows one should take into consideration not only the enormous amount of food required daily by the birds, but also note the dates on which the observations were made. It would seem impossible for some of the smaller birds mentioned to stow away in their small stomachs so many caterpillars in so short a space of time. But the dates alone will indicate to those familiar with the life histories of the insects that where the greater numbers were eaten the caterpillars were quite small, and such is the fact.

The facts given below were ascertained by Messrs. Mosher and Kirkland : —

Birds feeding on the Gypsy Moth Caterpillars.

May 12. — A yellow warbler ate 15 caterpillars in less than five minutes.

May 12. — A Nashville warbler ate 42 caterpillars in one-half hour, in the mean time taking many more.

May 18. — A scarlet tanager ate upwards of 30 caterpillars within five minutes.

May 18. — Two scarlet tanagers together ate small caterpillars at the rate of 35 a minute for eighteen minutes.

May 20. — A crow blackbird ate 40 caterpillars in a little over three minutes.

May 26. — A Maryland yellow throat ate 52 caterpillars while moving in and out among trees; time could not be taken.

May 26. — A redstart ate 31 caterpillars while moving about; time could not be accurately taken.

– – A red-eyed vireo ate, in four brief visits to an infested tree, 37 caterpillars.

July 13. — A yellow-billed cuckoo ate 1 every two minutes for thirty-six minutes.

July 13. — A red-eyed vireo ate 73 in forty minutes.

July 14. — A yellow-billed cuckoo ate 81 in forty-eight minutes.

July 15. — A towhee ate 7 pupæ and 2 caterpillars in a very short time; exact time not noted.

Birds feeding on the Brown-tail Moth Caterpillars.

May 2. — A robin pecked into a mass of caterpillars five times, taking a number each time; they could not be counted.

May 11. — A pair of blue jays ate 47 caterpillars in eighteen minutes.

May 11. — A black-and-white warbler ate 15 caterpillars in ten minutes.

May 12. — A rose-breasted grosbeak ate 57 caterpillars in twenty minutes.

May 15. — A chestnut-sided warbler ate 28 caterpillars in about twelve minutes.

May 16. — A scarlet tanager ate 44 caterpillars in seventeen minutes.

May 19. — A redstart ate 11 caterpillars within five minutes.

May 19. — Two scarlet tanagers ate, one 9 and the other 16 caterpillars in four minutes.

May 22. — A pair of chickadees ate, one 15 and the other 21 caterpillars in seven minutes.

May 23. — A red-eyed vireo ate 43 caterpillars in ten minutes.

May 23. — A blue jay ate 30 caterpillars in a very brief stay; no time given.

May 24. — A Baltimore oriole ate 34 caterpillars in six minutes.

May 24. — A red-eyed vireo ate 29 caterpillars in six minutes.

May 25. — A scarlet tanager ate 43 caterpillars in twelve minutes.

May 26. — A yellow-throated vireo ate 14 caterpillars in less than five minutes.

May 26. — An indigo bird ate 16 caterpillars; time could not be accurately taken.

Birds feeding on the Tent Caterpillars.

May 9. — A golden-winged warbler ate 14 caterpillars very rapidly.

May 10. — A red-winged blackbird ate 22 caterpillars in twenty-five minutes.

May 10. — A Baltimore oriole ate 14 caterpillars in six minutes, 27 in eight minutes and 10 in three minutes.

May 10. — A robin ate 30 caterpillars in a trifle over four minutes.

May 10. — A black-and-white warbler ate 12 caterpillars in a very short time, and fed for nine minutes, though not in plain view.

May 11. — A Nashville warbler ate 8 caterpillars in three minutes.

May 15. — A Baltimore oriole ate 15 caterpillars from a web in a very short time, and 9 more twenty minutes later.

Birds feeding on the Forest Tent Caterpillars.

Although the forest tent caterpillars have appeared recently in enormous hordes in many sections of New England and some adjacent States, they have not been numerous in eastern Massachusetts, and there have been no such opportunities to observe birds feeding upon them as have been presented with the other three species. Incidentally, however, the observers have noted that birds were searching out and eating the forest tent caterpillars, not merely taking them as they came in their way, but where one was found they searched for others, and ate them as they found them, carrying some away, presumably to their young. From what has been seen there seems little doubt that all those birds which eat the other hairy caterpillars would also take those of the forest tent caterpillars if they were numerous.

Birds feeding their Young.

During the observations made on the enemies of the gypsy moth it was noted that many birds were carrying caterpillars to their young, and birds were often seen to feed their young with caterpillars, which in most instances were readily taken by the young, although occasionally they were rejected. The observations made on the tent caterpillar were mainly made before there were young in the bird nests, but birds feeding on the brown-tail moth caterpillars frequently took them away.

Few detailed observations have been made as yet at the nests. The following birds have been seen carrying hairy

caterpillars to their young, or feeding them, or both: black-and-white warbler, blue jay, scarlet tanager, wood thrush, chickadee, yellow-throated vireo, red-eyed vireo, crow, catbird, black-billed cuckoo, yellow-billed cuckoo, yellow warbler and chestnut-sided warbler.

Those birds which not only eat hairy caterpillars but also feed them to their young are doubly useful, because of the enormous amount of insect food required by young birds. Our experiment shows that young crows weighing fifteen and one-half to sixteen ounces require at least ten ounces of food each day for their growth and development. Professor Treadwell fed a young robin in twelve hours forty-one per cent more than its own weight in worms. The same bird consumed nearly half its own weight of beef in a day.

Young birds must have animal food in order to grow and develop rapidly, and this food consists mainly of insects. An idea of the constant feeding required by the young may be gained from the following brief account of the work of two pairs of birds during the greater part of the day.

On June 13, 1899, Mr. Mosher watched a pair of red-eyed vireos feeding their young. There were three young about a day old in the nest. It was near the ground and the birds could readily be observed. The observer did not reach the nest until nearly 7 A.M. (when the birds had already been feeding their young probably for at least two and one-half hours) and left at 5 P.M., at which time the day's work was not finished, so that this cannot be considered a complete record of the day. Visits were made by one or other parent, —

Between 7 and 8, 14 times.	Between 12 and 1, 9 times.
Between 8 and 9, 9 times.	Between 1 and 2, 12 times.
Between 9 and 10, 12 times.	Between 2 and 3, 15 times.
Between 10 and 11, 7 times.	Between 3 and 4, 13 times.
Between 11 and 12, 16 times.	Between 4 and 5, 18 times.

making altogether 125 visits in ten hours. As these young birds were very small, only a few insects were brought each time, and most of those brought were so small that they could not be positively identified; but caterpillars form a considerable part of the food of these birds at this season.

On June 12, 1899, Mr. Mosher watched the nest of a pair of rose-breasted grosbeaks from early morning till 5 P.M. The nest was about fifteen feet from the ground, in a slender white birch. The ground was covered with hazelnut bushes, in which he found partial concealment; but for the first half hour the old birds were so excited by his presence that the feeding of the young birds was interrupted, so that no notes were taken until 6 A.M., and none were taken after 5 P.M.

The old birds visited the nest, —

Between 6 and 7, 52 times.	Between 12 and 1, 32 times.
Between 7 and 8, 47 times.	Between 1 and 2, 38 times.
Between 8 and 9, 43 times.	Between 2 and 3, 41 times.
Between 9 and 10, 30 times.	Between 3 and 4, 22 times.
Between 10 and 11, 36 times.	Between 4 and 5, 58 times.
Between 11 and 12, 27 times.	

making altogether 426 visits during the portion of the day that they were watched. The food was mainly caterpillars of one kind or another, and there were only four visits made by a parent bird when but one insect was fed to the young; they usually brought three or more. A bird often carries in this way from three to eleven or twelve small caterpillars in its mouth and beak at one time Owing to the height of the nest above the ground, it was impossible to determine accurately the species of caterpillars brought to the young. A considerable proportion of them were certainly leaf rollers from the oak trees. It seems probable, then, that these two birds must have fed their young on that day at least one thousand insects, mostly caterpillars. This certainly is a very moderate estimate of the number of insects destroyed in one day by the family, when we take into consideration the food required by the old birds. It is impossible to estimate how many of these insects were hairy caterpillars.

It will be noted that the grosbeaks made many more visits to the nest and carried much more food than the vireos. This is accounted for by the age of the young, the vireos being just from the egg and the grosbeaks being nearly ready to fly and very much larger.

Dr. C. M. Weed, in a paper entitled "The feeding habits of the chipping sparrow," published by the New Hampshire Agricultural Experiment Station, has given a very accurate record of the feeding of the young of two chipping sparrows during the entire day, beginning at 3.40 A.M. and ending at 7.49 P.M. The nest contained three young sparrows nearly fledged. His observations show that the birds feed their young during the long days of June from fifteen to sixteen hours, and that there was no long interval during the day when they were not at work. The birds visited the nest one hundred and eighty-two times. Food (mainly insects, including many caterpillars) was brought nearly every time, though some of the trips of the birds seemed to be made to furnish sand for grinding the food for the young birds.

Comparative Usefulness of Certain Families of Birds.

In going over the lists of birds which have been seen to destroy different species of hairy and spiny caterpillars, it is interesting to note that nearly the same families are represented in each list.

The Cuckoos (Cuculidæ).

It is generally acknowledged that the cuckoo is an exception to the generally accepted rule that the birds do not eat hairy caterpillars. There is no question as to the value of the cuckoos in this respect, but they feed mainly on the medium-sized and larger caterpillars. The two common American species seem even to prefer hairy caterpillars to the smooth ones, and their diet of these insects sometimes results in their stomachs becoming lined with the prickly hairs, which become embedded in the stomach coating. This, however, does not appear to inconvenience the birds. Whether there is any other family that is as useful in this respect as the cuckoos is still an open question. Our observations show that great numbers are eaten by other birds.

The Woodpeckers (Picidæ).

Woodpeckers certainly do not destroy as many hairy caterpillars as the cuckoos. They appear to take them only when they come in their way. They have been observed to maim and kill without eating.

The Flycatchers (Tyrannidæ).

The flycatchers eat very few hairy caterpillars, but destroy a great many of the imagoes of the diurnal species, two kingbirds having been observed to kill about two hundred and fifty male moths of the *Porthetria dispar* in less than three hours, and many female moths as well. Many flying moths are destroyed by the flycatchers.

The Crows, Jays, etc. (Corvidæ).

This family is represented by the blue jay and crow, both species being among the most useful in the destruction of medium-sized and full-grown hairy caterpillars. The observations on these birds made within the last three years prove them to be more useful in this respect than was even suspected. They are continually feeding where outbreaks of hairy caterpillars occur, eating both the caterpillars and pupæ, and feeding them to their young. These birds, because of their size and voracity, destroy enormous numbers of these larvæ. It is a question whether the crows do not destroy many more than the cuckoos, because of their larger size and greater numbers. Crows destroy fully as many pupæ as larvæ.

The Orioles (Icteridæ).

The Baltimore oriole and crow blackbird are exceedingly useful. As the feeding habits of these birds have become better known, their usefulness as feeders on hairy caterpillars has been recognized. They eat mainly the medium-sized and larger larvæ.

The Finch and Sparrow Family (Fringillidæ).

The finch and sparrow family is represented in Massachusetts by many species, several of which do not appear in the list of those attacking hairy caterpillars; but probably most sparrows eat such caterpillars to some extent. The chipping sparrow, song sparrow, towhee and rose-breasted grosbeak feed persistently upon them. Several observers have seen the indigo bunting attacking them. The sparrows eat both large and small caterpillars.

The Tanagers (Tanagridæ).

The tanagers are potent enemies of the hairy caterpillars wherever they appear in numbers in the woods, feeding quite constantly upon them. Our later observations indicate that no bird is more useful in woodlands.

The Vireos (Vireonidæ).

The vireos or warbling flycatchers are persistent caterpillar hunters, and destroy many of these creatures. They do not feed so readily on the full-grown caterpillars as on the smaller, but none are safe from their attacks.

The Warblers (Mniotiltidæ).

It was not until 1899 that the value of the warblers as caterpillar eaters was fully established. As they are small birds and feed mainly on the smaller larvæ, it is very difficult to determine by observation exactly what they are feeding on.

A special effort was made during 1899 to secure accurate data in regard to the destruction of the smaller hairy caterpillars by warblers. The result has demonstrated that warblers certainly are among the most useful birds in this respect, especially during the early part of the season, when most larvæ are small. They appear so fond of these larvæ that they will even cling and climb about on the trunks of the trees to get them. This is noted as a contrast to their usual habit of searching on twigs and branches.

The Mocking Thrushes (Miminæ) (Subfamily).

Represented by the catbird and brown thrasher, they are certainly among the most useful birds. The catbird eats hairy caterpillars greedily, destroying even those covered with spines, like the *Euvanessa antiopa*, and feeds many caterpillars to its young. It eats full-grown caterpillars about as readily as do the cuckoos, taking mainly those that have perhaps escaped more arboreal birds by remaining in the shrubbery near the ground.

The Wrens (Troglodytidæ).

The house wren is the only species that has been seen by our observers to eat hairy caterpillars. It can hardly be called a common bird, and it has only occasionally been seen to eat these caterpillars.

The Nuthatches and Titmice (Paridæ).

The chickadee, the common representative of the titmouse family, and one of the most useful of all birds, is a great destroyer of hairy caterpillars. Not only does it eat caterpillars of all sizes, feeding them to its young, but it destroys all forms of these insects, except perhaps the eggs of some species. Too much cannot be said in favor of this most useful and harmless bird. Both species of the nuthatch take these larvæ only as they come in their way on the trunks of the trees, and not always even then.

The Thrushes (Turdidæ).

While the thrushes eat hairy caterpillars when they come in their way, they do not, with the exception of the robin, appear to search them out. The robin seems to be in this way the most useful of all the thrushes. The wood thrush and Wilson's thrush occasionally visit localities infested by the caterpillars and eat a few, but the robin visits them frequently and eats many. The thrushes eat mainly the larger caterpillars.

The bluebird is useful in destroying most forms of these insects; but as bluebirds are not plentiful in the infested region, the opportunity for observation has not been so good as in the case of some other species.

Birds observed feeding on Hairy Caterpillars.

Yellow-billed cuckoo, . . .	*Coccyzus americanus* (Linn.).
Black-billed cuckoo, . . .	*Coccyzus erythrophthalmus* (Wils.).
Hairy woodpecker,. . . .	*Dryobates villosus* (Linn.).
Downy woodpecker, . . .	*Dryobates pubescens* (Linn.).
Yellow-bellied sapsucker, . .	*Sphyrapicus varius* (Linn.).
Flicker, ...	*Colaptes auratus* (Linn.).
Kingbird, ...	*Tyrannus tyrannus* (Linn.).
Great-crested flycatcher . .	*Myiarchus crinitus* (Linn.).

Phœbe,	*Sayornis phœbe* (Lath.).
Wood pewee,	*Contopus virens* (Linn.).
Least flycatcher,	*Empidonax minimus* (Baird).
Blue jay,	*Cyanocitta cristata* (Linn.).
Crow,	*Corvus americanus* (Aud.).
Red-winged blackbird,	*Agelaius phœniceus* (Linn).
Baltimore oriole,	*Icterus galbula* (Linn.).
Purple grackle or crow blackbird,	*Quiscalus quiscula* (Linn.).
Chipping sparrow,	*Spizella socialis* (Wils.).
Field sparrow,	*Spizella pusilla* (Wils.).
Song sparrow,	*Melospiza fasciata* (Gmel.).
Towhee,	*Pipilo erythrophthalmus* (Linn.).
Rose-breasted grosbeak,	*Habia ludoviciana* (Linn.).
Indigo bunting,	*Passerina cyanea* (Linn.).
English sparrow,	*Passer domesticus* (Linn.).
Scarlet tanager,	*Piranga erythromelas* (Vieill.).
Red-eyed vireo,	*Vireo olivaceus* (Linn.).
Yellow-throated vireo,	*Vireo flavifrons* (Vieill.).
Warbling vireo,	*Vireo gilvus* (Vieill.).
White-eyed vireo,	*Vireo noveboracensis* (Gmel.).
Black-and-white warbler,	*Mniotilta varia* (Linn.).
Parula warbler,	*Compsothlypis americana* (Linn.).
Yellow warbler,	*Dendroica æstiva* (Gmel.).
Chestnut-sided warbler,	*Dendroica pensylvanica* (Linn.).
Maryland yellow-throat,	*Geothlypis trichas* (Linn.).
Black-throated green warbler,	*Dendroica virens* (Gmel.).
Oven-bird,	*Sciurus aurocapillus* (Linn.).
American redstart,	*Setophaga ruticilla* (Linn.).
Catbird,	*Galeoscoptes carolinensis* (Linn.).
Brown thrasher,	*Harporhynchus rufus* (Linn.).
House wren,	*Troglodytes ædon* (Vieill.).
White-breasted nuthatch,	*Sitta carolinensis* (Lath.).
Red-breasted nuthatch,	*Sitta canadensis* (Linn.).
Chickadee,	*Parus atricapillus* (Linn.).
Wood thrush,	*Turdus mustelinus* (Gmel.).
Wilson's thrush,	*Turdus fuscescens* (Steph.).
American robin,	*Merula migratoria* (Linn.).
Bluebird,	*Sialia sialis* (Linn.).
Cedar waxwing,	*Ampelis cedrorum* (Vieill.).

Birds feeding on the Pupæ or Imagoes.

Yellow-billed cuckoo.	Phœbe.
Black-billed cuckoo.	Wood pewee.
Hairy woodpecker.	Least flycatcher.
Downy woodpecker.	Blue jay.
Yellow-bellied sapsucker.	Crow.
Kingbird.	Baltimore oriole.
Great-crested flycatcher.	Chipping sparrow.
Towhee.	Black-and-white warbler.

Rose-breasted grosbeak.	Yellow warbler.
Indigo bunting.	American redstart.
English sparrow.	Catbird.
Scarlet tanager.	Brown thrasher.
Red-eyed vireo.	Chickadee.
Yellow-throated vireo.	Robin.

Bluebird.

Assuming that our observations have proved that birds eat hairy caterpillars, it may be interesting to inquire why this fact has not been previously noticed. It will be seen at once, by one who makes a study of the subject, that the error which has been so long persisted in arises, first, from a lack of careful observation.

It is not strange that the cuckoos should have been known for years to feed on hairy caterpillars. The cuckoos are sizable birds; they are not shy, and as they feed on the larger caterpillars when those insects are full grown, and as both cuckoos and caterpillars are common in the vicinity of dwellings, their habits in this respect could not escape the most casual observer. But to observe the habits of shy birds, such as the crows and jays, which feed on the larger caterpillars, is much more difficult; and to learn the feeding habits of the smaller birds, which feed mainly on the minute larvæ soon after these larvæ have hatched from the egg, is still more difficult. Reliable observations of this class can be made only by trustworthy and skilled observers, who can devote time to the task.

But it may be asked, Why have not those who have dissected the stomachs of the birds discovered that they were eating hairy caterpillars to a considerable extent? To this it may be answered that up to the present time most of the knowledge that has been gained in regard to the destruction of hairy caterpillars by birds has been gained from stomach examinations, and it is by stomach examinations mainly that light has been thrown on this question. Yet he who examines the stomachs of small birds labors under many difficulties in determining the specific character and quantity of food of this class. Minute caterpillars are speedily reduced to a pulpy mass in the bird's stomach. While the field observer may readily identify the small tent caterpillars, for instance, on which the birds are feeding, and even count

the number eaten, it might be impossible for the man in the laboratory, working without exact knowledge of the conditions under which the bird was shot, to do either. Many of the larger caterpillars eaten by the smaller birds are not swallowed whole, but picked to pieces, therefore the portion of the caterpillar swallowed would be entirely unrecognizable when found in the bird's stomach. Other caterpillars are dissected, as it were, by the bird, and only the internal parts chosen as food; these cannot be identified in the bird's stomach. Orioles, vireos, warblers, titmice and tanagers are among the birds which commonly dissect caterpillars in this way. This is not a rare or exceptional habit, nor is it difficult to observe. It seems to be a device adopted by the smaller birds mainly when feeding on the larger caterpillars. These caterpillars are probably too large to be swallowed whole by small birds without causing some inconvenience, so they choose the parts which can readily be digested, and reject the others.

Wilson Flagg says that he saw an oriole in a black cherry tree kill in one minute seventeen caterpillars, and noticed that the oriole did not swallow the insect, but set his foot upon it, tore it asunder and swallowed an atom taken from the inside. "Had he eaten the whole caterpillar," says Flagg, "three or four would probably have satisfied his appetite. But the general practice of birds that devour hairy caterpillars is to eat only a morsel, hence they require greater numbers to satisfy their wants."

Mr. Mosher records an instance where a red-eyed vireo came into a tree, taking brown-tail moth larvæ, swallowing the smaller ones and pulling the larger ones to pieces, afterwards swallowing some of the pieces. He saw it eat fifteen in the eight minutes it was in sight.

The warbling and yellow-throated vireo have often been observed to do this, though the habit is not constant even with individual birds. A red-eyed vireo was seen to take a forest tent caterpillar, beat it with his bill, pull it to pieces and eat all the pieces. The next one was treated in the same way, except that he ate the inside only, dropping the skin and head to the ground. Another red-eyed vireo was seen to eat seventy-three gypsy moth larvæ in forty minutes.

The caterpillars were large, and he held them with his foot, pulled out certain inner parts and ate them, discarding the rest. This is a common practice with the chickadees. They hold the larvæ with their feet mainly, tearing them open and devouring a portion or all of the internal parts, leaving the head and skin untouched. From personal observation and corroborative facts obtained from other observers I am led to believe that this is a habit with many birds. The crows, jays, chickadees and some of the woodpeckers also have the habit of killing caterpillars which they do not eat. Whether the caterpillars are dropped accidentally or wantonly destroyed in mere sport is not known, but many are certainly killed in this way. The blue jays' habit of pecking caterpillars and dropping them to the ground has been previously noted by Dr. C. M. Weed in the ninth annual report of the Ohio Agricultural Experiment Station, in quoting from the observations of Mr. E. V. Wilcox. Different species of warblers have also been seen to eat portions of the larger caterpillars, leaving the external parts. A black-and-white warbler was seen to beat a forest tent caterpillar on the ground until she had torn it in pieces, when she took the inside parts and flew away to her nest, leaving the remainder on the ground. She did not return for the parts left.

These things can be learned only by observation, and it will be readily seen that when birds feed in this way it is impossible for one examining the stomach contents to get, by this method alone, an accurate or even an approximate idea of the value of the bird as a destroyer of hairy caterpillars. Birds cannot feed to any extent on hairy caterpillars where such larvæ are few, and unless the dissector knows whether such caterpillars were obtainable where his birds were taken he cannot form an accurate idea of the value of the bird in this respect.

Birds materially restrict the Increase of Hairy Caterpillars.

The writer has earnestly endeavored to determine to what extent birds control the increase of hairy caterpillars. The result of the investigation is not as yet conclusive, but much can be deduced from the array of facts presented.

It is certain that many birds prefer smooth-skinned caterpillars. Many species have not been observed to eat hairy caterpillars at all, while it is safe to say that most land birds feed readily upon smooth-skinned caterpillars. Take, for example, the larvæ of the canker-worm moths, *Paleacrita vernata* and *Anisopteryx pometaria.* Nearly all species of birds in eastern Massachusetts, from the titmouse to the crow, have been observed to feed upon these larvæ, and when these are abundant most birds seem to prefer them to the hairy caterpillars. The tent caterpillars, hatching as they do very early in the season, form when small a staple food for a great number of birds. Later, as the canker worms appear and the tent caterpillars grow larger and presumably more disagreeable to some birds, they are neglected to some degree, while most birds feed on the canker worms. When the canker worms disappear many birds again resume feeding on hairy caterpillars. The presence of a quantity of smooth-skinned caterpillars, therefore, indirectly benefits the hairy caterpillars.

Every one who has studied carefully the life history of moths has been struck with the great mortality among the young larvæ. In a study of the natural increase of the gypsy moth it was found that where a single egg-cluster hatched isolated from its kind most of the caterpillars disappeared while they were quite small; in some cases the entire brood was destroyed.

It is well known that the gypsy moth in Massachusetts has few effective natural enemies except the birds. Birds frequently have been observed feeding upon the young caterpillars, and careful observation indicates that many of them are destroyed by birds before they are half grown. Two instances have been reported where small but flourishing colonies of gypsy caterpillars appear to have been exterminated by birds. Limited outbreaks of the brown-tail moth that have been watched have been so reduced that at the end of the season few or none could be found. Just what proportion of this destruction is due to the parasites and other enemies of the brown-tail moth it is difficult to determine, but the observers are agreed that most of it is due to birds. In some cases the webs of the tent caterpillar

are torn open by birds and all or nearly all of the caterpillars in the webs destroyed.

The most striking instance observed of the check exerted by birds on the increase of hairy caterpillars was in Georgetown, Mass., in July, 1899. Here a colony of the gypsy moth had grown and flourished in the woods unknown to any one until it was discovered in midsummer. The moths had been increasing there without any check excepting their natural enemies, and they had defoliated the trees and shrubbery on at least two acres of land, stripping both pine and hard-wood trees. A vast swarm of caterpillars had been at work there. It was noticeable, however, that the caterpillars were not nearly so numerous at the time of their discovery as they had been in other localities where they had not done so much injury; in other words, there were not enough caterpillars to account for the destruction of the foliage. The colony was near the edge of the woods, with a field and meadow on one side and an orchard near by. Birds abounded in the vicinity. So soon as one came within hearing distance of the place cries of crows and blue jays were heard in and about the edges of the stripped tract. Many chickadees, tanagers, thrushes, warblers, sparrows, flycatchers and cuckoos were about. At the foot of some of the large trees hundreds of dead and dying caterpillars were found which evidently had been injured by the beaks of birds. Mr. Mosher watched the locality for a few days and found many species of birds feeding on the caterpillars. He noticed that whenever he left the locality many crows came in and fed. There were very few parasites and other enemies of the gypsy moth in the vicinity, and the conclusion naturally arrived at was that enormous numbers of caterpillars had been destroyed by birds. Thus only could the evident great reduction in the numbers of the caterpillars be accounted for. Many birds were destroying the moth in all its forms, and, while they had not succeeded in suppressing the outbreak, it was plain that they were exerting a strong restrictive influence upon the increase and spread of this injurious insect.

Recapitulation and Conclusion.

It is to be regretted that it is impossible, because of lack of space, to present in this brief paper more than a few of the carefully recorded facts, through a comparison of which the following conclusions have been reached, and it is hoped that another opportunity for publishing at least a part of these recorded observations may offer.

To recapitulate: —

1. The widely accepted belief that hairy caterpillars have immunity from the attacks of birds (excepting only the cuckoo) is erroneous.

2. This error has arisen partly from a lack of painstaking observation, partly from the inadequacy of stomach examinations alone to determine the full value of many birds in this respect, and partly from the well-known partiality evinced by many birds for smooth-skinned caterpillars.

3. During most of the time when the young birds receive their food from the parents they require a great quantity of animal food, which consists mainly of caterpillars and other soft-bodied insects.

4. The parent birds, being overworked at that season in defending their young from many enemies and in providing sufficient food both for themselves and young, take such caterpillars as are most plentiful and readily obtained.

5. The most destructive hairy caterpillars are gregarious, and many of them reach their maximum of destructiveness usually when many of the young birds are in the nests. The presence of these caterpillars is marked by the evidence of their destructiveness. Their presence is readily detected at a distance by birds, which visit places where such food can be readily obtained in quantities. About forty species are known to visit such places, feeding largely on the caterpillars, while many of them take them to their young. When the young are fledged they are led by the old birds to such localities and taught to feed themselves.

6. An abundance of smooth-skinned caterpillars, which many birds prefer, tends to limit the destruction of hairy caterpillars by birds.

7. Birds as a class must be considered as a potent factor in regulating the increase of those moths whose caterpillars are covered with hairs or spines. Many outbreaks of such species are "nipped in the bud" by birds, and they have a large share in the repression of the greater outbreaks.

8. As certain hairy caterpillars are among the worst pests known to the farmers and fruit growers, those birds which destroy such caterpillars, and which are also in other ways to be considered among our most useful species, should be protected, even if some of them take small wages of fruit to pay for their services.

REPORT

OF THE

STATE BOARD OF AGRICULTURE

ON THE WORK OF

EXTERMINATING THE GYPSY MOTH.

Commonwealth of Massachusetts.

To the Massachusetts State Board of Agriculture.

Your committee in charge of the work to prevent the spreading and secure the extermination of the gypsy moth in this Commonwealth presents herewith a report of expenditures made and work performed during the year 1899.

The balance of the appropriation for 1898 on hand Jan. 1, 1899, was $5,862.74. This balance was apparent rather than actual, since it was practically exhausted for bills incurred for labor and supplies during the preceding December. The law empowers your committee, in common with other State departments, to continue expenditures during the month of January, "until the pleasure of the General Court is made known, at the rate of expenditure authorized by the appropriations for the preceding year." By this arrangement, active operations against the moth were carried on throughout the month.

At this time the examination of the woodland in the infested district was continued when the weather permitted. During storms and after heavy snow falls the work was confined to the woodland colonies, where the eggs of the moth were destroyed, the dead and sickly trees cut and the remaining trees put in condition for burlapping. Owing to the rigorous weather of the season, the force, numbering some four hundred men January 1, gradually diminished by resignations and sickness to about three hundred and fifty men at the close of the month. The Legislature having failed to make provision for continuing the work, active field operations were discontinued February 1, the tools were recalled from the field and the force suspended indefinitely.

An emergency appropriation of $30,000 became available February 15, but the remarkably heavy snow storm of February 12 and 13 prevented the resumption of field operations until February 22, when the force was again put at work completing the cutting and thinning of infested woodlands. Since the expenditure authorized by law for the month of January was deducted from this appropriation, only $13,333.33 remained for prosecuting the work. This balance sufficed to carry on operations with a force numbering about three hundred men until about March 9, when the field work was again discontinued, The history of previous years was repeated, and the main appropriation of $170,000 did not become available until April 15. Thus over a month of valuable working time was lost, at a season when operations against the moth can be carried on with especial advantage.

The unfortunate interruptions of the work in the spring months had two equally undesirable results: (1.) The clearing up of large areas of infested woodlands, a preparatory measure absolutely essential to the effective treatment of those regions, was perforce neglected until nearly the hatching time of the eggs, after which this measure was impracticable. (2.) With the spring demand for labor, a number of our skilled employees, men whose experience made them especially valuable to the work, had sought and obtained other and more permanent situations, and their services were thus lost to the Board.

Where woodlands are infested, it is of prime importance to destroy the egg-clusters in the fall and winter. The economy of this practice will be understood, when it is recalled that the destruction of a single egg-cluster saves the labor that otherwise would be required the following summer for searching out and killing by hand the five hundred or more caterpillars that would hatch from the cluster. Further, the winter work of cutting underbrush and dead and worthless trees does away with the hiding-places of the insect, and drives the caterpillars to the remaining trees for food and to the burlaps for shelter, where they are readily found and killed. Another economy is effected by the reduction in the number of trees on a given infested area,

which correspondingly reduces the number of burlaps required and the labor necessary in attending them.

The loss each spring of experienced help deserves more than a passing mention. The work against the gypsy moth is unique, and for its successful prosecution demands the services of trained and expert employees. The problem of exterminating the gypsy moth is in its essentials simply one of the continuous application of skilled labor in the methods shown by experience to be effective. Where skilled and unskilled labor can be obtained in the market at an equal price, good business policy dictates the employment and retention of experienced men only, as is illustrated by the common practice of large corporations and other similar bodies. This has been the policy of your committee, but its efforts have been thwarted in part by the annual loss of a considerable number of its most capable and expert employees. Thus the delayed appropriations and the consequent suspensions of the work have annually produced conditions which are undesirable, illogical and expensive.

As soon as the main appropriation was available, the force was reorganized by the recall of its former members, the reinstatement of many employees of previous years and the hiring of new men. In this manner the number of employees was gradually increased to its maximum of five hundred and forty-three on July 1.

During the latter part of April the general inspection of the territory and the killing of egg-clusters were continued, and the work necessary before putting on the burlaps was completed as far as possible. A large supply of burlap and insecticides was purchased and prepared for use. It had been decided to concentrate the efforts of the year on the work of destroying larvæ under the burlaps, and to this end over two million three hundred thousand trees were burlapped. On about one million other trees the burlaps of the previous year were in a serviceable condition. In the latter part of May spraying operations were commenced. While the dry season favored the rapid development of the caterpillars, it was also exceedingly favorable for the work of spraying, which was continued into June with most excellent results. The examination of the burlaps occupied the

entire force during the latter part of June and July, and to the constant attention at that time to this method of fighting the moth is due the extermination of several colonies and the notable reduction of many others. Later in July, and during the first two weeks in August, while the insects were in the pupal stage, considerable areas of infested brush land were burned over. During the fall months a large number of infested towns were scouted, infested stone walls were sprayed with oil, and the work of treating the egg-clusters in infested woodlands was prosecuted with the utmost vigor. The burlap season having passed, the force was gradually reduced to about two hundred men, by the discharge of those employees who could be spared with the least detriment to the work. The details of the year's work and a statement of the condition of the several cities and towns in the infested district are given in the report of the acting director.

A phase of the work against the gypsy moth that has not received the attention it would seem to deserve is the matter of securing the co-operation and aid of the national government. The existence of the gypsy moth in this Commonwealth is a constant menace to the agricultural and forestry interests of the country; and, in protecting the property of her own citizens from damage by the moth, Massachusetts has also protected the property of those living in the adjoining States; in fact, parts of all the New England States are nearer the infested district than the more remote towns in Berkshire County. The direct routes of travel leading from the metropolitan district would facilitate the distribution of the moth over the eastern United States, and should the work of combating the insect be suspended, this undesirable result would follow as a natural sequence. While the probable size of the area through which the moth would become established should it be allowed to increase and spread unrestricted furnishes an interesting field for speculation, the problem also has a practical bearing, the importance of which can hardly be over-estimated.

The distribution of leaf-eating insects is generally governed by the distribution of their chosen food plants. Unfortunately, the gypsy moth caterpillar exhibits no marked

Pines, oaks and other trees stripped by the omnivorous caterpillars of the gypsy moth. Georgetown, July 11, 1899.

preferences, but feeds as readily on the oak, chestnut and pine as upon the apple, peach and pear. Careful experiments have also shown that even the cotton plant may be included in its menu. In fact, the moth has been known to feed upon not less than four hundred and fifty-eight species of trees and plants. Were the existing restrictions removed, it would seem possible that the moth would become established, and prove a formidable pest in all those regions of our country where the apple, peach, pine and cotton flourish; and this conclusion finds support in the well-known habits and distribution of the insect in its native home. The chief factor that would prevent such a condition of affairs would be the occurrence and multiplication of parasites and other natural enemies in numbers sufficient to check the development of the moth. The assumption that this would actually occur seems hardly warranted in view of the moth's gradual but continuous increase in Massachusetts throughout the twenty years preceding the inception of the attempt to secure its extermination. In spite of the many birds and parasites that are known to prey upon it here, the moth where neglected soon increases to formidable numbers. While it is of vital importance to our own agricultural interests that the pest should be eradicated in our State, it is apparent that the problem has a significance not limited by State bounds. The State of Massachusetts has courageously attempted to deal with this pest. To secure the desired end, her tax-payers have supported the work with liberal appropriations. Having demonstrated the possibility of exterminating the insect, and having for years protected other States from damage from this pest, it would seem that the Commonwealth might now with justice request and receive national assistance in bringing this important undertaking to a successful issue. If steps are taken to secure the co-operation of the national government, it would seem to be even more incumbent upon the State to provide liberally at the present time for the vigorous prosecution of this work.

One of the most unfortunate conditions existing in the area over which the gypsy moth is distributed is the general infestation of woodlands which have been set apart for

parks. The magnificent Lynn woods reservation, a park area which possesses in a remarkable degree the natural features so desirable in a woodland park, has been in the past so thoroughly infested with the moth that many trees in restricted areas have been defoliated. The same unfortunate conditions have prevailed to a much greater degree in the beautiful Fells reservation of the metropolitan park system.

Since the existence of large colonies of the moth in these areas was a constant menace to the surrounding woodlands, and would result in the devastation and death of many of the trees, your committee has taken vigorous measures, so far as funds would permit, to stamp out these infestations. Wherever such work has been necessary in the Fells reservation your committee has freely sought and as freely received the co-operation of the Metropolitan Park Commission. The respective objects of the two bodies are in entire harmony. The Park Commission has endeavored to secure and maintain woodlands and other areas suitable for park purposes, thus contributing to the enjoyment, comfort and health of the inhabitants of the metropolitan district. The object of your committee has been to preserve trees and other vegetation from devastation and destruction by the moth.

The heroic measures which are practicable and economical in the case of ordinary woodlands have not been adopted in treating the colonies in the park system; but, in order that the integrity and beauty of the parks might be maintained, many modifications in methods, involving a greater amount of hand labor, have been made even at a material increase in the cost of the work. At Pine Hill, Medford, for example, it seemed desirable from the stand-point of the Park Commission to preserve as many as possible of the young pines springing up in the underbrush. To eradicate the moths from this colony, it was practically a necessity to cut and burn the underbrush, thus driving the insects to the trees where they might be taken under the burlap. By modification of this method of work, the young pines were preserved, although the expense of the necessary operations was greatly increased. In this and many other instances

Seedling pines defoliated and killed by the gypsy moth.

your committee has gladly co-operated with the Park Commission, in order that the objects of both bodies might be successfully attained. It is perhaps well to indicate, however, that the work against the moth in all woodland parks must be performed at an increased expense over that on similar infested areas held by individuals, where it is not always necessary to preserve the shrubbery and underbrush.

Notwithstanding the fact that the work against the gypsy moth was begun under a misconception of the size of the infested area, and has been handicapped and imperilled by reduced and delayed appropriations, constant progress, on the whole, has been made toward the desired end. It is, however, but just to say that, supported by the liberal appropriations of the past two years, nearly as much progress has been made toward the extermination of the moth as in the entire seven years previous to 1898. These appropriations have enabled your committee to carry out in nearly all their details the plans for dealing with the entire infested area, and the results now apparent fully justify the liberal financial policy of the Legislatures of 1898–99. Had there ever been any doubt as to the complete possibility of exterminating the gypsy moth, it would have been dispelled by the results obtained during the past two years.

Under the former system of reduced and delayed appropriations, it was practically impossible to prevent the increase of the moth in certain parts of the infested district while the work of reducing its numbers was going on in other parts. When special attention was paid to the reduction of the moth in the outer towns, the inner towns were necessarily neglected, thus affording centres of infestation from which the insects could again spread into the outer areas which had been cleared; in fact the rapid multiplication of the numbers of the moth in the central woodlands in the years 1895–97 resulted in serious devastation of these wooded areas, and menaced the success of the entire work. In 1896–97 there were in the infested district woodland areas containing gypsy moth egg-clusters best numbered by millions. In the woodland colonies of Saugus alone, for example, in the winter of 1896–97 approximately one million egg-clusters were killed by hand, while perhaps as many

more were destroyed by fire. During the past fall a careful search of these colonies by skilled employees resulted in the finding of less than one hundred egg-clusters.

The only unfortunate developments of the past year are the finding of colonies of the moth in Newton and Georgetown. The discovery of these colonies is not surprising, in view of the large number of gypsy moths that were necessarily allowed to increase in the woodlands of the infested district in the years of restricted appropriations. In fact, the finding of outside colonies has been repeatedly predicted in past reports. It would not be surprising if similar colonies should be found in the near future near the border of the infested district. Such colonies being usually restricted in their area, and well isolated, their extermination presents no unsurmountable difficulty.

From the results of the past two years, it is evident that the work against the gypsy moth in Massachusetts is already approaching its final stages. The large colonies have been practically wiped out; many of the smaller colonies have been exterminated or are thoroughly under control, and need but two or three seasons' work to secure their absolute extermination. Three years ago there were many localities in the infested district where there were large masses of egg-clusters. To-day the infestation of the region consists of the scattered remains of former colonies and their offshoots, which must be subjected to careful and continual examination and treatment for a series of years. Since there are no longer large colonies to demand attention, a greater amount of labor will be available for this work of inspection and the treatment of the smaller colonies.

During the ensuing year, should suitable funds be made available early in the year, all localities where egg-clusters were found during the fall inspection should be cleared up and made ready for burlapping. The work of examining the towns not yet inspected should be prosecuted with the utmost rapidity consistent with thorough work, and any findings of the moth promptly stamped out and the infested areas cleared up. If this work can be prosecuted without unnecessary delays during the year 1900, the entire territory will be in better condition for the summer's work than ever

before. It is believed that the season's work under these conditions will yield better results than have heretofore been attained.

Your committee has found in the results obtained during the past two years an ample justification of the estimate of the probable annual needs of the work as given by Professor Fernald in his report to this committee, January, 1897. To carry out its plans for the ensuing year, the committee, therefore, recommends that the sum of $200,000 be spent along the lines indicated. It is unnecessary at this time for the committee to reaffirm its belief that the entire extermination of the moth is a possibility. The results of the past two years' work are sufficient to dispel any doubt on this point, and to make it plain to the most skeptical that if sufficient funds can be provided for a few years longer the accomplishment of the desired end will be an assured fact.

The well-known position which your committee has consistently maintained during the past years has been repeatedly endorsed by the country's most prominent economic entomologists. No less an authority than Dr. L. O. Howard, entomologist to the United States Department of Agriculture, has frequently examined the work of the committee's employees in the infested district, and as frequently expressed confidence in the ultimate extermination of the moth should sufficient funds be provided. The following resolution was passed at the meeting of the Association of Economic Entomologists at Columbus, O., Aug. 19, 20, 1899: —

Resolved, That the Association as a body endorses and commends the work of the gypsy moth committee of the State of Massachusetts in continuing the extermination of this pest.

The resolutions adopted at the annual Farmers' National Congress are given below: —

Whereas, The Farmers' National Congress is familiar with the efforts made by the Commonwealth of Massachusetts to exterminate the gypsy moth; and

Whereas, On former occasions it has endorsed this undertaking by resolutions; and

Whereas, The existence of the gypsy moth in Massachusetts is believed to be a standing menace, not only to the agricultural and forestry interests of that State, but to all sections of our country; it being further believed that its spread into other States would in a very short time become a national misfortune and an ever-increasing source of financial loss and annoyance to our people: —

Resolved, That this Congress heartily appreciates and applauds the great work already done by the Commonwealth of Massachusetts, and we believe that she is entitled to the gratitude of all our people in appropriating a million dollars in the attempt to exterminate this pest from our land; and be it further

Resolved, That, recognizing the certainty of the gypsy moth becoming a great national pest, should the efforts of Massachusetts fail at a time when complete extermination seems more than a mere possibility, we earnestly appeal to the Congress of the United States to come to the aid of the Commonwealth of Massachusetts, and, by the appropriation of moneys and in other ways, secure to our people absolute freedom from this dread insect pest.

The length of time required to secure the absolute extermination of the gypsy moth depends wholly upon the action of the Legislature. Should the work be delayed or handicapped by an insufficient appropriation, much of the ground gained during the past two years will be lost; the insects will increase in the woodland colonies and eventually spread into the outer towns, from which they can only be exterminated by large outlays of money. If, on the other hand, this work receives the timely financial support it deserves, there is every reason to believe that it can be prosecuted to a favorable conclusion.

Owing to continued ill health, the director of field work, Mr. E. H. Forbush, was granted leave of absence for three months, dating from October 19. During the eight years in which Mr. Forbush has had charge of the work against the gypsy moth he has given to the State services whose importance and value can hardly be over-estimated. It is but a pleasant duty for your committee to record its high appreciation of the worth of a most faithful official.

During the director's temporary absence his duties have been discharged by Mr. A. H. Kirkland, formerly assistant entomologist to the committee.

As in previous years, the advice and assistance of Prof. C. H. Fernald, entomologist to the committee, has been freely asked and as freely given. The accurate fulfilment of the results predicted by Professor Fernald sufficiently indicates the high value of the advice which long experience and well-ripened judgment enable him to give.

The following is the financial report of the gypsy moth committee to the State Board of Agriculture for the year 1899:—

Financial Statement for 1899 — Gypsy Moth.

Balance on hand Jan. 1, 1899,		$5,862 74
Appropriation for the year 1899, $200,000, from which $10,000 was set aside for preventing the spread of the brown-tail moth, leaving, for the gypsy moth,		190,000 00
		$195,862 74
Wm. R. Sessions, expenses,	$10 65	
E. W. Wood, expenses,	21 91	
Augustus Pratt, expenses,	76 93	
F. W. Sargent, expenses,	32 48	
J. W. Stockwell, expenses,	8 89	
N. I. Bowditch, bill not presented,	–	
John M. Danforth, expenses,	30 55	
C. H. Fernald, expenses and remuneration,	561 08	
E. H. Forbush, director, salary,	2,400 00	
Travelling expenses of director and men,	1,927 88	
Teaming, livery and board of horses,	5,295 18	
Wages of employees,	167,278 31	
Rent of office, storehouse and land,	484 00	
Supplies, tools, insecticides, printing, etc.,	17,662 43	
	$195,790 29	
Balance on hand Jan. 1, 1900,	72 45	
		$195,862 74

E. W. WOOD,
AUGUSTUS PRATT,
F. W. SARGENT,
N. I. BOWDITCH,
JOHN M. DANFORTH,
J. W. STOCKWELL,

Committee on the Gypsy Moth, Insects and Birds.

Report of the Entomologist.

To the Committee on the Gypsy Moth.

Gentlemen: — The work of exterminating the gypsy moth has been carried on during the present season with marked success, and the insect has been reduced to such an extent over almost the entire territory that one who has kept in close touch with the work for several years past cannot fail to be impressed by the great gain that has been made towards the extermination of this pest.

Extermination by the State Possible.

There is no longer any question in the minds of those who have made a careful personal investigation of the work throughout the infested territory that the gypsy moth can be exterminated. Nearly all of the prominent economic entomologists of this country have inspected the work with great care and thoroughness, and have become fully convinced that extermination is possible, if the Legislature each year makes the full appropriation called for by the gypsy moth committee. Their conclusions on this subject, published in previous reports of this committee, show that all expert testimony is in favor of continuing this work till extermination is accomplished.

The most extended investigations have been made by Dr. L. O. Howard, entomologist to the United States Department of Agriculture, who has made exceedingly thorough examinations of the work during the last three years, and has repeatedly expressed the opinion that it is possible to exterminate the gypsy moth, if the full appropriations asked for are made by the Legislature.

In a letter from Dr. Howard, dated Oct. 23, 1899, he writes as follows: "The condition of the entire territory is admirable; it surpasses my expectations of two years ago,

Oak woodland defoliated by gypsy moth caterpillars.

and far surpasses my expectations of the past midsummer, when I learned of the two new outside colonies. The fact is, that the field force, under such experienced field superintendents as you now have, is now able without hesitation to do exactly the right thing in such emergencies as those of the past summer, and to do it promptly and without waste of effort. It has taken all these past years to arrive at such a condition of affairs."

Cost of Extermination.

In my report of January, 1897, to this committee, I gave an estimate of the time and money that would be required to exterminate this insect, which was an appropriation of not less than $200,000 a year for a term of not less than five years, and then an appropriation of not less than $100,000 a year for a term of not less than five years, after which an appropriation of perhaps $15,000 a year for a period of five years would be required. Wishing to obtain the opinion of Dr. Howard on this estimate, I wrote him, and, in a letter dated Feb. 20, 1899, he writes as follows: "I think your estimate of the time it will take to exterminate the gypsy moth, as published in the reports and bulletins of the gypsy moth committee, is reasonable, and I think that, if the money is appropriated and made promptly available, extermination will be accomplished, as you prophesy." The Legislature has not given the required appropriations until the last two years. Even then $10,000 each year of the necessary appropriation was required to be spent on the brown-tail moth, and there have also been unfortunate delays in granting these appropriations. Yet, from the results of the last two years, I am more than ever convinced that the insect can be exterminated in the time indicated, if the full amount asked for each year be promptly appropriated.

Who should be interested in this Work.

There can be no doubt that each taxpayer in the Commonwealth of Massachusetts should be interested in this work, and, in justice to himself, consider whether it is possible for the State to exterminate this insect; and, in this case, whether it will cost him more in taxes than it would

to fight the insect himself when it reaches his premises. To determine this question, we have only to consider that the value of the taxable property in this State is $2,429,832,-966, and an appropriation of $200,000 is a tax of less than one-twelfth of a mill on a dollar. A man having taxable property to the amount of $5,000 will have to pay a tax of only 41 cents and 6 mills for this purpose. If we suppose a man on a $5,000 farm should have to pay this tax annually as long as he carries on the farm, say, forty years, the sum total of his tax during all those years would amount to $16.64, which is far less than it would cost him to clear the gypsy moth from his premises in a single year. Such a farmer in the western part of the State can look upon this tax as a premium paid to the State to protect him from damage by the gypsy moth, in the same way as a premium paid an insurance company protects him from loss by fire. If, however, the Legislature continues to adopt the recommendations of the gypsy moth committee till the pest is exterminated, this tax will continue but a comparatively few years.

The Action of the Legislature.

The only uncertainty at the present time about extermination is the action of the Legislature. There are members of this body who have taken time to investigate the gypsy moth work thoroughly. They have gone over the infested territory and studied the problem very carefully from every point of view, with the result that they realize the full gravity of the situation; the great destruction that this insect would cause if allowed to spread over the State; the impossibility of extermination or of successfully dealing with the pest by individuals or even municipalities; and they are also convinced that the State can and ought to furnish the means necessary for the absolute extermination of this insect. There are others who, unfortunately, have had neither time nor opportunity to investigate this work, and they may not be familiar with such problems. I am not surprised that such persons should think it impossible to exterminate the moth, for several noted economic entomologists held the same opinion before visiting the infested

territory; but after making a careful inspection, they invariably became convinced not only that extermination was possible, but that it was the manifest duty of the State to carry on the work to completion.

The experience of the past nine years has proven conclusively that when the appropriations are reduced one-third or one-half, as was the case for several years, little or no gain is made towards extermination, and therefore this policy results in an absolute waste of public money. If, therefore, the Legislature will not appropriate the full amount required for the successful prosecution of this work, it would be better to make no appropriation whatever. The best interest of every tax-payer in the Commonwealth of Massachusetts demands that the Legislature shall promptly grant the full appropriation asked for by the gypsy moth committee.

Respectfully submitted,

C. H. FERNALD.

Report of Acting Field Director.

To the Committee on the Gypsy Moth.

In presenting a report on the field operations against the gypsy moth during 1899, the acting director aims to give a brief history of the year's work, a detailed statement of the infestation of each town, a summary of the condition of the entire infested district, and a few general considerations which may be of interest to the tax-payer.

History of the Year's Work.

During January experienced employees were kept at work scouting for the moth in the woodlands of Lynn, Peabody, Salem and Swampscott, and in the residential portions of Chelsea and Wakefield. A part of the force was engaged in chopping, and at times when the snow was deep the entire force was utilized in cutting over infested woodlands in Arlington, Lincoln, Lynn, Malden, Medford, Salem, Winchester and Woburn. In this manner large areas of infested scrub growth were cleared up, while infested timber lands were thinned and made ready for burlapping. This work was prosecuted as rapidly as possible until the close of the month.

With the resumption of the work on February 22, scouting was continued in Belmont, Malden, Saugus and Wakefield, when the weather favored, while a considerable amount of cutting and burning was done in Arlington, Lexington, Malden, Medford, Saugus and Woburn. These operations were interrupted on March 9, when the emergency appropriation became exhausted.

The late date on which the main appropriation became available, April 15, made it imperative that all possible killing of eggs should be done before the hatching period. Accordingly, this work was prosecuted vigorously over the

General view of the Georgetown woodland colony, showing stripped trees in the background.

entire district, but particularly in Malden and Medford, where large numbers of egg-clusters still remained. Early in May, as the eggs began to hatch and the young larvæ to spread, infested brush lands were burned over with oil, thus destroying many infestations of considerable size, and preventing a farther spread of the insect. The large amount of preparatory work, such as egg killing, cutting and burning, etc., which had been done in the months which had elapsed since the laying of the eggs in midsummer, 1898, had placed the entire district in a condition where the burlap could be better attended than ever before. Fifty-three tons of burlap were purchased and made ready for application to the trees. A large number of employees was added to the force, and the work of burlapping was carried on as rapidly as possible.

The work was continued without delay during the early part of June, and, as a result, over 2,300,000 trees were banded with the burlap, while on over 1,000,000 others the bands of last year were still serviceable. The foliage was now developed to such an extent that spraying operations could be prosecuted with advantage, and twenty gangs with the improved tank outfits were kept at work applying the poison to the leaves. Spraying is an expensive operation under the best conditions, and in previous years the effectiveness of this work has been often nullified in part by frequent rains. From our stand-point, however, the climatic conditions in the season of 1899 were all that could be desired. Under the influence of clear, dry weather the poison was applied easily, and as readily dried on the foliage. The effectiveness of this treatment was soon apparent in the thousands of dead caterpillars that covered the ground beneath the infested trees. This method was particularly satisfactory in dealing with colonies in the metropolitan park system, where it seemed undesirable to use more radical measures. Later in the month when the larvæ began to cluster, spraying operations were gradually discontinued, and special attention was given to the destruction of the insects under the burlaps.

Throughout July the inspection of the burlaps was carried on diligently. In the worst colonies, daily or even semi-

daily inspections were the rule; in other colonies, the burlaps were examined every second or third day. In residential districts, where small colonies were widely scattered, bicycle gangs were organized among the employees, and by this system the colonies received constant and thorough attention. As the insects approached the pupal stage, infested walls were burned out with oil, and areas of brush land in which the larvæ had appeared were also burned with the oil spray.

The beginning of August marked the termination of the larval and pupal seasons. The burlaps were given a final inspection, and all places where the treatment could be used with advantage were thoroughly burned with oil spray. The burlap season having passed, the field work was discontinued from August 18 to September 5. The work of removing the burlap was begun early in September, a search for eggs being made at the same time. As the process of hunting for egg-clusters is necessarily a slow one, the removal of the burlaps was not completed until near the end of the month. In woodland colonies all serviceable burlaps were left on the trees for the next year. The fall inspection was prosecuted rapidly in the outer towns. In the inner towns, egg killing, burning of brush and tinning of cavities in infested trees received the attention of a large number of employees. The numbers of the force were gradually reduced by suspension and discharge, the most experienced men being retained for the fall inspection.

In October the work of scouting and egg destruction was continued. Towns which had not been examined for two or three years were given a thorough search, and all findings of the moth promptly stamped out. Considerable attention was given to tinning cavities in infested fruit and shade trees, thereby destroying many hiding-places of the moth. Infested walls noted during the fall inspection were sprayed with oil in order to destroy the egg-clusters, — a method which is both cheap and effective. A large amount of effort was directed towards clearing up the newly found colonies in Newton and Georgetown. These localities were scouted by trained men, who were followed by gangs of

choppers. In this way the scattered infestations were located, cleared up, and the territory put in excellent condition for burlapping.

During the early part of November the work of scouting and clearing woodland colonies received the attention of the major part of the force. Later, an examination was made for the brown-tail moth in several of the more northern towns, and, as the leaves had fallen from the trees, the work of destroying this insect was commenced. Nearly the entire force was engaged in this work from November 9 to 23, when, as the appropriation had become nearly exhausted, field operations were discontinued. The field superintendents and their assistants were retained during December, and their services utilized in examining important outlying colonies, — a work requiring the greatest possible skill, and for which they are exceptionally well fitted.

Summary of the Year's Work.

In the following summary there are given only such data as can be accurately compiled. In the reports issued previous to January, 1898, there were recorded the numbers of each form of the moth killed. These figures were compiled at a considerable expense, and in the past three years we have transferred this expenditure to field labor, believing that the field work should have all possible financial support. The records of the daily work of our employees are on file and may be examined at the office of the committee.

Work Done.

Trees inspected,	17,487,105
Trees banded with insect-lime,	301
Trees burlapped,	2,304,552
Trees sprayed,	10,752
Trees cut,	468,790
Trees trimmed,	99,597
Trees scraped,	3,794
Trees in which cavities were covered,	8,896
Buildings inspected,	9,554
Buildings infested,	571
Fences inspected (rods),	49,854
Fences infested,	561
Stone walls inspected (rods),	16,321

Stone walls infested,	363
Stone walls burned (rods),	2,053
Stone walls sprayed (rods),	3,495
Brush cut and burned (acres),	2,559
Ground burned over with oil (acres),	151
Ground burned over without oil (acres),	155
Ground sprayed with oil (acres),	11

Number of Employees in 1899.

Jan. 2-Jan. 7,	403	July 3-July 8,	531
Jan. 9-Jan. 14,	390	July 10-July 15,	531
Jan. 16-Jan. 21,	395	July 17-July 22,	527
Jan. 23-Jan. 28,	359	July 24-July 29,	520
Jan. 30-Jan. 31,	85	July 31-Aug. 5,	515
Feb. 1-Feb. 4,	27	Aug. 7-Aug. 12,	501
Feb. 6-Feb. 11,	30	Aug. 14-Aug. 18,	498
Feb. 13-Feb. 18,	39	Aug. 19-Aug. 26,	29
Feb. 20-Feb. 25,	282	Aug. 28-Sept. 4,	29
Feb. 27-March 4,	319	Sept. 5-Sept. 9,	315
March 6-March 9,	336	Sept. 11-Sept. 16,	316
March 10-March 11,	68	Sept. 18-Sept. 23,	306
March 13-March 18,	28	Sept. 25-Sept. 30,	297
March 20-March 25,	22	Oct. 2-Oct. 7,	253
March 27-April 1,	26	Oct. 9-Oct. 14,	231
April 3-April 8,	26	Oct. 16-Oct. 21,	224
April 10-April 15,	185	Oct. 23-Oct. 28,	214
April 17-April 22,	289	Oct. 30-Nov. 4,	213
April 24-April 29,	363	Nov. 6-Nov. 11,	209
May 1-May 6,	414	Nov. 13-Nov. 18,	201
May 8-May 13,	461	Nov. 20-Nov. 23,	189
May 15-May 20,	473	Nov. 23-Nov. 25,	36
May 22-May 27,	520	Nov. 25-Dec. 2,	32
May 29-June 3,	516	Dec. 4-Dec. 9,	33
June 5-June 10,	512	Dec. 11-Dec. 16,	32
June 12-June 17,	513	Dec. 18-Dec. 23,	32
June 19-June 24,	529	Dec. 25-Dec. 31,	32
June 26-July 1,	543		

False Alarms.

As stated in another place in this report, the distribution of the bulletin on the gypsy moth has stimulated attention on the part of the public toward insect depredations. As was expected, this has led to the sending to this office of an unusually large number of false complaints of damage by

the gypsy moth. This is as it should be. Our attitude in this matter has been that it is better to investigate hundreds of cases of supposed damage rather than to overlook a single case of actual injury by the gypsy moth. To this end it is hoped that property owners will continue their activity in noting unusual insect injury, and report all suspicious cases promptly to this office.

A list of non-infested towns which have been visited because of complaints received is given below: —

Acton.	Dedham.	Lowell.
Andover.	Essex.	Newburyport.
Barnstable.	Framingham.	Norwood.
Billerica.	Gloucester.	Quincy.
Boxford.	Greenfield.	Rockport.
Bradford.	Hamilton.	Topsfield.
Braintree.	Haverhill.	Wellesley.
Brookfield.	Holliston.	Wenham.
Canton.	Hull.	Westford.
Chelmsford.	Hyde Park.	Westwood.
Concord.	Ipswich.	Wilmington.

Outside Colonies.

As in past years, infestations have appeared in the regions lying outside the boundary line established in 1891. Since this line was determined by a hasty search by untrained men, and not by a careful tree-to-tree examination by skilled inspectors, it has often seemed remarkable to those most familiar with the work that so few outside colonies of the moth have developed. In most of these colonies there is not lacking abundant internal evidence to show that they date back to the years of the moth's greatest abundance, 1889–91, a time when the caterpillars were swarming forth in large numbers from the centres of infestation.

Of the two outside colonies found the past year, the one in Newton is the most extensive, while the trees in the Georgetown colony suffered the most severe injury. Without doubt the Newton colony is a result of traffic between the residences of citizens of the locality and certain estates in a town known to be infested. A careful investigation

shows that certain families living in the infested district in Newton have been accustomed in the past nine years to visit and receive visits from other families living in generally infested localities in Arlington.

The colony in Georgetown centres on the site of an abandoned farm, where for several years a Melrose poultry dealer was accustomed to make stays of considerable length. His home place at Melrose was for years overrun with the moth, and it was his practice to leave his wagon and poultry crates standing near infested trees for considerable periods of time. Having disposed of a load of poultry, he would return to Georgetown and collect another stock of fowls in that vicinity, calling frequently at the farm mentioned. There can be but little doubt that this continued traffic was the means of transporting the moth to Georgetown.

The condition at Newton well illustrates one evil of reduced appropriations. With the pressure of work elsewhere, the Board has never been able to do more, since the hurried, preliminary survey of 1891, than to inspect the northern strip of Newton contiguous to the infested towns of Brighton, Waltham and Watertown; to examine a few localities elsewhere in the city most liable to infestation; and to inspect the adjoining West Roxbury district of Boston and the town of Brookline, and the main routes of travel and localities most exposed to infestation in Weston, Wellesley, Needham and Dedham.

Since we have never been able to obtain sufficient funds to permit a thorough examination of all the outlying towns, we have early appreciated and adopted the suggestion made by Dr. L. O. Howard, entomologist of the United States Department of Agriculture, in his comprehensive report on the work against the gypsy moth.*

A bulletin describing the habits and appearance of the moth was prepared, as suggested by Dr. Howard, and distributed throughout the towns adjacent to the infested district. In this way public attention has been called to all unusual insect damages. The value of this procedure has been shown in the finding of the Newton colony, which was

* "The Gypsy Moth in America," Bulletin No. 11, new series, Division of Entomology, United States Department of Agriculture, 1897.

located as a result of the perusal of the bulletin by one of the owners of the infested estates. The bulletin has been distributed in the following cities and towns: —

Acton.	Gloucester.	Quincy.
Andover.	Groveland.	Randolph.
Bedford.	Hamilton.	Rockport.
Billerica.	Haverhill.	Rowley.
Braintree.	Hyde Park.	Sudbury.
Boxford.	Ipswich.	Tewksbury.
Burlington.	Lincoln.	Topsfield.
Canton.	Middleton.	Wayland.
Carlisle.	Milton.	Wellesley.
Chelmsford.	Natick.	Wenham.
Concord.	Needham.	Weston.
Danvers.	Newbury.	Westwood.
Dedham.	Newton.	West Newbury.
Dover.	North Andover.	Wilmington.
Essex.	North Reading.	
Framingham.	Norwood.	

Two factors have been of importance in the development of outside colonies. The spreading of the moth from the woodland colonies in the years of restricted appropriations has been accompanied with grave dangers. More important, however, has been the great dissemination of the insect in the early years, when its activities were practically uncontrolled.

Since so few infestations, comparatively, have developed, it is probable that now, in the eleventh year since the moth outbreak (and consequently greatest spread) of 1889, sufficient time has elapsed for the development and discovery of any colonies started six to ten years ago. From the beginning of the work the efforts of the Board have been directed to keeping the main avenues of travel and public places in infested towns free from the moth, thus guarding against this very danger of distribution. For years past the moth has been reduced to a minimum in the very places where the chance of distribution was the greatest. But even if outside colonies should develop in the future, their occurrence, unless they are larger, more numerous or farther

removed from the centre of infestation than those heretofore found, — conditions which hardly seem probable, — is not so serious a menace to the success of the work as the enforced neglect, necessary in the years of diminished appropriations, of large infested woodland colonies in the central district. The acreage of the outside colonies is seldom large; that of the inside woodland colonies is numbered by hundreds. Outlying colonies are generally well isolated, and their extermination, where sufficient funds are provided, is not a matter of great difficulty.

Condition of the Infested Region.

The detailed description of the condition of the infested towns will afford a proper basis for a summary of the condition of the entire district. Under "outer towns" are included those towns lying between the central infested region and its border. The "central towns" are those lying nearest the centre of infestation and are most generally infested.

Outer Towns.

Arlington. — The condition of Arlington shows a gratifying improvement. But few places have been found infested in the residential part, and in the majority of these only scattered caterpillars were taken. The woodland colonies were thoroughly worked with good results. They still need thorough and repeated examinations, and, if these can be given them, their extermination is assured. In the fall of 1899 the entire burlapped area was carefully inspected, and but few nests were found. A considerable amount of territory beyond the burlaps was also inspected, and three small colonies were located. These colonies are restricted in area, and their extermination is not a difficult problem. There yet remain a few colonies where the cavities in the trees should be closed and the loose bark removed, and in others dead trees and brush should be cut, after which all the infestations in the town will be in the best possible condition for rapid extermination.

Belmont. — There are probably more worthless, hollow fruit trees and brush infested stone walls in Belmont than

in any of the towns in eastern Massachusetts, and these two factors have been of grave importance in preventing the extermination of the moth here. In spite of these obstacles notable progress towards extermination has been made in the residential district. In the northern part of the town limited infestations have been found in the brush and woodland areas. The whole town should be carefully inspected before the hatching period, and all infestations put in shape for exterminative measures. If this cannot be done, extensive colonies may develop here; if it can be done, and these measures applied, the extermination of the moth from Belmont will not be difficult of accomplishment.

Boston. — In Dorchester and Roxbury but 5 caterpillars were taken under the burlaps. In South Boston three times the area was burlapped the past season that was covered in 1898. The burlaps were carefully attended, and no trace of the moth was discovered throughout the entire season. Three former colonies in East Boston have been apparently exterminated. At Orient Heights the infested vacant lots have been cleared up, the fruit and shade trees trimmed, and exterminative work is now well in hand. Boston proper, Roxbury and Dorchester should now be thoroughly inspected by experienced men to guard against the repetition of such an outbreak as occurred several years ago at Sargent Street, Dorchester. This work should be done early in the season, so that if an infested spot is located, it can be cleared up at once before the hatching time.

Brookline. — Since the finding of the colonies in this town in 1896 sufficient time had elapsed to allow any straggling moths from these colonies to increase to a point where their presence could be easily detected. A thorough inspection of the residential district was made last spring. As a result of this examination, it seems probable that the infestations in Brookline have now been located. A small number of larvæ were taken at different points in the town during the past summer. At the Schlesinger colony, where a formidable outbreak of the moth occurred in 1896, only 2 larvæ were found in 1899. At the Crafts colony there has been no trace of the moth found in 1898 or 1899, and the insect has been probably exterminated there.

Burlington. — Two of the formerly large colonies appear to be exterminated, as no form of the moth was found in them during 1899. During the past fall it became possible for the first time in years to inspect a part of the woodland areas. Two colonies of considerable importance were found near places formerly infested, and in another locality a single egg-cluster was found. All of the colonies have been thoroughly worked over and put in excellent condition for the operations of next year, when, if they receive proper attention, their extermination should be accomplished.

Cambridge. — Scattered larvæ have been taken in Cambridge during the past season. Two small infestations in the vicinity of Fresh Pond demand thorough attention. Because of the large amount of valuable trees and shrubbery in this city, the more heroic methods of fighting the moth cannot be followed; hence, to secure extermination there will be needed in the future an increased amount of hand labor at an increased expense. Cambridge is in a condition for thorough exterminative measures, and as soon as there are no badly infested centres from which the city may become reinfested, such measures should yield most satisfactory results.

Chelsea. — All the trees in this city were burlapped in 1899, and repeatedly examined. Less than one-fourth as many larvæ and only about one-sixth as many egg-clusters were found as in the previous year, the larger number having been found near the old infested centres adjacent to Everett. To exterminate the moth in Chelsea it will be necessary first to suppress the general infestations in Everett and Malden, and then to pay constant attention to the burlaps for a few years.

Georgetown. — If evidence were needed that the gypsy moth has lost none of its notorious capacity for harm, the scenes presented in July last at the Long Hill colony in Georgetown afforded alarming proof of the fact. The gypsy moth caterpillars swarmed over three acres of woodland, on two acres of which the trees stood as bare as in midwinter. Pines, oaks, elms, maples, birches and hickories, together with the underbrush and herbage, were alike stripped. Reliable local observers, who watched the colony during

the days preceding the beginning of operations by the employees of the Board, report that the rapid progress of the hungry caterpillars from the colony into the unscathed surroundings was astonishing. The spreading of the caterpillars in their search for food was likened to the fire from a carelessly dropped match eating its rapid way outward over the dry forest floor.

On July 10, when this woodland colony was first visited by the agents of the Board, the sight presented beggars description. The great majority of the caterpillars, having deserted the stripped tract in their search for food, were massed in wriggling bunches up and down the trunks and along the under sides of limbs of the trees standing on the borders of the newly invaded woodland. The continual dropping of excrement from the masses of caterpillars produced a sound resembling the pattering of rain. But in spite of this exodus, the bare, stripped centre of the colony was by no means deserted by the insects. The comparatively small minority of the caterpillars remaining crawled by thousands in all directions in their search for food. Over the bare, unshaded forest floor, and up and down the sun-scorched trunks, even out to the very tips of the branches, the larvæ were hurrying; but the pupæ outnumbered the larvæ, and their brown bunches hung on every hand. The spectacle vividly recalled the almost incredible tales told of the now historic moth-outbreak of a decade ago in Medford. The condition of affairs called for drastic measures, especially as the female moths were beginning to emerge and lay their eggs. Fire and the axe were applied, as the most economical and speedy method of dealing with the colony. The trees were felled, and thrown with their festoons of pupæ and clusters of eggs, into bonfires; the flame of the cyclone burner was applied to ground, ledges and walls, and all remains of the moth were done away with.

The Long Hill colony, which was of considerable size at its height, is situated in the eastern part of Georgetown, at the Rowley line. Since the obliteration of the heart of the colony, the work of the latter part of the year has been chiefly confined to thinning out woodland, by felling a large

portion of the trees and clearing away the underbrush in a wide circle around the original centre of infestation. Ninety acres of woodland have been thus put into condition for burlapping work in the larval season of 1900. Trees left standing in this partially cleared space will average upward of one hundred and twenty-five to the acre. They are large, sound and smooth-barked, and can be quickly inspected. Probably it will be necessary to continue some thinning in January over about forty acres more of woodland. Some portions of the ground should be burned over with oil in the spring to destroy larvæ which may arise from broken egg-clusters. The fall inspection of the woods surrounding the colony has been extended on the north, south and east for about half a mile, and for a shorter distance on the west. Only 9 egg-clusters were found, all being near the original infested tract. The finding and stamping out of this rather compact colony before the larvæ had scattered very far or many eggs had been laid was most fortunate. While it is to be presumed that some local distribution of the insect has taken place, from all indications not many caterpillars will be found under the burlaps in the summer of 1900.

Lexington.—For the first time since 1895 a thorough inspection of the entire town was made during the winter and spring of 1898–99. A few small colonies were found, all of which are natural off-shoots of the woodland colonies in Arlington and Winchester, which perforce were badly neglected in the years of diminished appropriations. These small colonies have been put in good condition, and the burlaps inspected almost every day during the larval season. It is apparent that the moth has been exterminated from many of these colonies. The woodland colonies of the south-eastern part of the town, once as badly infested as any in the entire district, are now in excellent condition. In one colony, in which 1,962 larvæ were destroyed in 1897 and 353 in 1898, only 1 was found in 1899. In another colony, where 57,444 larvæ were destroyed in 1897 and 8,386 in 1898, but 626 were found in 1899. As the entire town was inspected during the year, the conditions

Employees using cyclone burners in the centre of the Georgetown colony. July. 1899.

are now accurately known, and, if means are provided, exterminative measures can be vigorously prosecuted.

Lincoln. — The condition of this town in its infested section is much improved since the year 1898. In the larval season there were in use 108,000 burlaps; in 1899 there were taken 190 larvæ, as against 22,840 in 1898. Only two new nests were found in the past year. In the old colony of 1897 more brush and wood cutting is required. The present infestation, while slight, is widely scattered, and the entire town of Lincoln should be inspected at the earliest possible moment. As pointed out in the last annual report, a few moths were found just over the Lincoln border in the town of Weston. In this region 24 larvæ were taken in 1898, nothing being found here in 1899.

Lynn. — During the spring of 1899 an inspection was made of the whole city, including the greater portion of the territory known as Lynn woods, a part of the park system lying contiguous to the Saugus colonies. As was expected, this inspection revealed slight infestations scattered through the woods. These areas were burlapped and attended during the summer, and at the close of the season very few larvæ had been found. The whole tract of woods should be given another inspection before the leaves appear in the spring. In the residential portion of the city a few infested places were found. Nearly all of these infestations can be ascribed to traffic from the central towns or woodland colonies. All of the infested places were burlapped and carefully attended during the summer. As yet it has been impossible to do the work of searching for eggs. Should this be accomplished before the hatching time, the entire city of Lynn will be in excellent condition and ready for exterminative measures.

Lynnfield. — No trace of the gypsy moth has been found in the northern and central parts of the town for a number of years. The small colonies in South Lynnfield known to be infested in 1898 were burlapped and attended during the summer of 1899. A few larvæ were taken under burlaps in one locality in that part of the town contiguous to the Saugus territory, which has been so badly infested in the past. So nearly has the gypsy moth been exterminated in

Lynnfield that little more can be done until the entire town has had, as a precautionary measure, a tree-to-tree inspection. This should be made without fail during the winter of 1899–1900, or before the leaves appear in the spring.

Manchester. — Special attention has been given to Manchester during the past season by as many men as could be spared for this work. More than 50,000 trees were burlapped at the beginning of the larval season, and inspected as often as possible during the summer. During the past fall the greater portion of the town, including the woodland, has received a careful inspection, and all of the infested localities have been cleared of eggs. Only 16 egg-clusters were found in the entire area examined, and these were in the worst-infested localities of the previous year. It will thus be seen that practically a year's work has reduced the moth from hundreds of thousands to the small number mentioned above. The town is now brought to a condition where the amount of labor and expense can be greatly reduced. After another year of carefully conducted work in a few localities there should be no form of the moth left in the town.

Marblehead. — No form of the moth was found during the year in any of the old colonies. In October an opportunity presented for a thorough inspection of the entire town. This inspection resulted in the finding of a few egg-clusters in three localities, — two of them near the railroad station, a centre of travel, and the other in the eastern part of the town, on an estate whose occupants have had frequent communication with the Hawkes farm in Saugus, which has been nearly overrun in the past with gypsy moths. This thorough inspection and the slight infestation found shows clearly that the gypsy moth has once been entirely exterminated from the town. It also shows that the town has become reinfested since the inspection of three years ago, and well illustrates the folly of allowing the moth to swarm in the large central colonies, as was necessarily the case in the years of reduced appropriations.

Nahant — A thorough inspection of this town was made in October, 1899. This inspection being concluded, on each of three estates there had been found one old nest and its

progeny. Nothing was found at or near the previously known places of infestation. This shows that the town had once been cleared of the gypsy moth and become reinfested since the last inspection, probably from the woodland colonies in neighboring towns, which were badly neglected because of reduced appropriations in 1895–97. All the infested places should be inspected and watched carefully next year.

Newton. — The finding of a colony of the gypsy moth in the Oak Hill district of Newton was directly due to the distribution of the danger bulletin, to which reference has been made in another part of this report. The owners of the infested estates, noticing unusual insect damage, became convinced, by the reading of the bulletin, that the pest in question was the gypsy moth, and at once notified this office. Work was begun in this colony the following day, June 22, by employees of the Board. A brush-infested pasture was burned over with oil, and over 40,000 trees were burlapped in the vicinity of the colony. Following the stamping out of the dangerous portion of the colony, the work of inspecting, cutting and burning was continued through the remainder of the year, with a view to preparing for exterminative work in 1900. A large tract has now been put in the best possible condition for burlapping next season. This work of thinning trees and cutting underbrush should be continued until the hatching time. In the mean time, the city should be thoroughly inspected. At the present time there are no extensive infested spots, but a few larvæ have been found scattered over a large area. Thorough work here another year should practically exterminate this colony.

Peabody. — Owing to the inspection given the town in the winter of 1898–99, and the results of constant work during the past summer, Peabody is in better condition as regards the gypsy moth than for some time past. The entire residential portion of the town was burlapped, and special attention was given to the work of inspection. During the larval season about 9,000 larvæ were taken under the burlaps. After the leaves had fallen, the woodland colonies and the residential part of the town were given a thorough inspection and cleaning. As a result of this work, only four localities were found infested, and in these but 16 egg-clusters

were taken. Next year burlaps should be used in and around these places, and watched carefully. There still remains a portion of West Peabody that should be inspected before the foliage appears in the spring. If this is done, and nothing found, the expense otherwise required for the work of next year in this town can be greatly reduced.

Reading. — Previous to the fall of 1899, our finances have never permitted a thorough inspection of Reading. In 1898 nothing was found in the places formerly infested. A close inspection of the entire town, made in October and November, 1899, by some of our most experienced men, resulted in the finding of a small colony in the western part of the town. In all, ten egg-clusters were destroyed there. This appears to be the extent of infestation west of Main Street; on the east side of Main Street are located several infested estates, and an infested area about one-eighth of a mile square lies south-east of the centre of the town in the residential portion. To exterminate the moth from Reading it will be necessary to clear up all the infested areas and put them in condition for burlapping. A large part of the town should then be burlapped, and the burlaps attended thoroughly. If these conditions can be fulfilled, the work of exterminating the moth from Reading is not a difficult problem.

Revere. — The condition of Revere now shows marked improvement. The underbrush in the Franklin Park section was cut and burned and the trees thinned previous to burlapping. Several vacant lots near the centre of the town were cleared, and the burlaps were well attended during the entire season, which resulted in the destruction of about three times the number of larvæ found in 1898. A close inspection of the whole town in the fall of 1899 developed less than one-third the number of egg-clusters taken in 1898. Revere will need attention so long as Malden and Everett remain infested; and before extermination can be accomplished in this town, a considerable amount of preliminary work, such as trimming, scraping, and closing cavities in infested trees, will be necessary.

Salem. — During the burlap season only two places were found infested, six larvæ being taken in the residential district. One of these places was near the Peabody line,

and the other in the southern part of the city, adjoining the Great Pastures. All of the infested localities found in the pastures during the last inspection were cleared of underbrush, and where necessary the ground was burned over during the past spring. The remaining trees were then burlapped, and attended closely during the season. All of the known infested places in the Pastures were given a careful inspection after the leaves had fallen, and a few egg-clusters were found in three different localities, in or near rock heaps or stone walls, favorite hiding-places of the moth. Should any form of the moth appear here another season, fire will quickly dispose of the insects. The work of the past two years has put this city in better condition than ever before. The ultimate extermination of the moth here depends entirely on frequent and careful inspections.

Somerville. — Only scattered larvæ have been found in Somerville the past year. None of the existing infestations are of especial importance. The city should be burlapped thoroughly next year, in order that any straggling larvæ may be found and destroyed. At the present time the conditions here are very favorable. Thorough work should exterminate the moth from Somerville as soon as the large Medford colonies near by are so reduced as to prevent reinfestation.

Stoneham. — But few caterpillars were found in the residential part of Stoneham during the summer of 1899, and in but two of the infested places were there more than a dozen caterpillars killed. Only two egg-clusters were found in the burlapped area when it was carefully inspected last fall. Only two or three small colonies were found last fall in territory that had not been inspected for five years. The southern part of the town contains woodland areas which have been generally infested, and which in former years contained several formidable colonies. Some of these colonies have been exterminated, while the others are in much better condition than last year. A considerable amount of undergrowth in this woodland should be cut before all the colonies can be put in condition for exterminative work. The entire town should now receive a thorough inspection.

Swampscott. — The entire town of Swampscott, including

the woodland, has been inspected during the year. A few larvæ were found during the burlap season in three of the most recent colonies. A careful fall inspection of the town was made, especially in the region where the moth has been the worst in years past, — particularly at Cedar Hill. Nothing was found in or near the old colonies. Outside of this region three small infested places were discovered, one of them situated near Phillips beach, the others in close proximity to the State road which has been built recently. Much traffic and travel passes near these points, and it is probable that they have thus become reinfested since the inspection of three years ago. All eggs have been treated, but there still remains a small amount of brush to be cut before the localities are placed in proper condition for burlapping next year. This should be done before the hatching time. Thorough and constant attention to the burlaps should then practically free Swampscott from the gypsy moth.

Wakefield. — The general inspection of this town, made in the winter of 1898–99, showed scattered infestations. The entire residential district and the infested woodland areas were burlapped and carefully attended during 1899. A larger amount of work was done in Wakefield than in any single previous year, and the results are manifest in a marked degree in the total number of moths found. Preliminary work — the clearing of underbrush, trimming out all dead wood, etc. — is being prosecuted in all infested localities. Thus all possible preparations are being made for exterminative measures; and, since the town is now but slightly exposed to the danger of reinfestation, it should receive constant and thorough attention for a few years.

Waltham. — Near an old colony in Waltham 8 larvæ were taken early in July, 1899. Because of the importance of this outlying infestation, more than an acre of ground in this vicinity was burned over, and 3,647 additional trees were burlapped. It seems probable that this colony has been exterminated. The entire city should now be inspected, in order that any reinfestations, should they be found, may be promptly stamped out.

Watertown. — While the condition of Watertown was excellent in 1898, it has been further improved during the past year. The only larvæ found were taken in Mt. Auburn ceme-

tery, which, from the immense amount of travel centring there, will probably remain slightly infested so long as the moth is abundant in the inner towns. No egg-clusters were found in the fall inspection. As the danger of reinfestation decreases, faithful attention to the burlaps, with an occasional search for eggs, will be the only work necessary in Watertown.

Winthrop. — During the season of 1899 all the trees in this town were burlapped, and received close attention. A few scattered larvæ were found. A careful examination at the end of the burlap season disclosed but a single egg-cluster. The town is now practically cleared of the gypsy moth. In common with other similarly located towns, Winthrop is somewhat exposed to the danger of reinfestation from the central district so long as the moth remains there in numbers.

Woburn. — The greater part of the residential district was burlapped and carefully attended during the summer. In one colony, where caterpillars were so numerous in 1897 as to necessitate burning with oil, no form of the moth was found this year. All told, a smaller number of caterpillars were destroyed this year than last, and but few egg-clusters were found in this section during the fall inspection. The northern portion of the city has not been scouted since 1895 until this fall, when a few small colonies were found. With but little effort these colonies can be put in shape for exterminative work. All the known woodland colonies are either entirely or nearly exterminated. In one woodland colony in 1898 392 caterpillars were destroyed; and in the same colony in 1899 only 3 were found. In another, 70 caterpillars were destroyed in 1898, and no form of the moth was found in 1899. There still remains an area in the northern portion of the city which should be inspected again.

Central Towns.

Everett. — Limitations of funds at critical periods have at times prevented the employment of active measures in this city, and, as a result, the condition is but slightly improved over that of former years. The infested areas are well known, and if circumstances enable us to make a thorough search for eggs before the hatching period, a large part of the city will be in condition for exterminative work in 1900.

Malden. — The present condition of Malden shows a substantial improvement over that of 1898. There were 256,691 burlaps in use; large areas of the worst infested centres were cut over and burned; extensive spraying yielded satisfactory results. Only about one-third as many larvæ and egg-clusters and half as many pupæ were found in 1899 as in 1898. There still remain in the eastern and northern parts of the city areas of infested woodlands, which should be thinned and put in condition for burlapping. Before exterminative measures are used, it will be necessary to cover the cavities in a large number of infested trees. The condition of the whole area being now accurately known, it is safe to assert that if continuous suppressive work can be carried on here for two successive years, exterminative measures may then be employed to good advantage.

Medford. — Since this city was the one in which the moth was originally introduced, its general infestation doubtless took place at an early date. The woodland colonies of Medford have for years been a most serious menace to the success of our work. Here the caterpillars have repeatedly swarmed in the years of restricted appropriations, and, being disseminated outward from the colonies, have reinfested the surrounding cities and towns. Hence the condition of Arlington, Cambridge, Somerville, Stoneham and Winchester, as regards the gypsy moth, has been largely dependent on that of Medford. In 1897 we were obliged — although it entailed the serious neglect of outer infested territory — to use most vigorous measures in these woodland colonies. Favored by more liberal financial support during the past two years, the work thus commenced in 1897 has been prosecuted vigorously, with the result that the woodland colonies are now well under control. The residential portion of the city is generally infested, and will probably remain so until the scattering of the moth from the woodland colonies has been prevented. The most regrettable condition in Medford is the general infestation of the wooded areas lying in the metropolitan park reservation. Drastic measures for dealing with the moth here are out of the question, and a vast amount of expensive and continued hand-labor will be necessary before the moth is exterminated from these woodlands.

Melrose. — The residential portion of Melrose contains scattered infestations, which are less numerous and extensive, however, than those in the corresponding part of Malden. Because of the large numbers of the moth in Malden in 1898, but little attention could be given to Melrose in that year, and, as a consequence, the insect increased to a considerable extent in the woodland colonies in the southern part of the town. It has been necessary to combat this increase during the past summer. Before substantial progress can be made, a considerable amount of preliminary work must be done. Underbrush and dead trees should be removed in the southern woodland colonies, and the cavities closed in a large number of infested trees. Vigorous suppressive measures will be necessary in Melrose for at least two years.

Saugus. — The notable reduction of the numbers of the gypsy moth in Saugus, made in 1897–98, has been more than maintained the past season. The large centres of infestation have been kept in good condition through the destruction of sprouts and underbrush and the clearing of ground still farther outward from these centres. Not only has the woodland section been much improved, but more work than ever before has been done in the farming and village districts of the town. Before exterminative work can be done in Saugus it will be necessary to trim a large number of infested trees, fill cavities in which the caterpillars might hide, and make general use of other well-known preliminary measures.

More than 305,000 trees were burlapped and inspected during the past summer. A greater number of burlaps distributed over a larger portion of the town than ever before were attended, and yet a smaller number of larvæ was taken in the entire town than has been found in the past on twenty square rods of infested woodland. A comparison of the number of caterpillars killed by hand during the past three years may be interesting: —

In 1897, over 3,522,000 larvæ in a small area of woodland.

In 1898, about 300,000 larvæ in a larger area, including both woodlands and residential districts.

In 1899, about 148,000 larvæ over nearly the whole town, and of this number 42,546 were taken outside the woodland.

No fall inspecting and cleaning for eggs has as yet been done, owing to pressure of work in outer towns. However, the whole town is now in a most excellent condition. To maintain this condition it is of the greatest importance that a thorough inspection and destruction of all the remaining egg-clusters be made before the hatching period in 1900.

Winchester. — This town has been generally infested by the moth, but the present condition of the colonies as compared with that of previous years is very satisfactory. Only about one-third as many caterpillars were found in the town this year as in 1898. The greater number of these were found in the south-eastern part, in or near the Middlesex Fells reservation. Repeated examinations of a large number of formerly infested estates failed to reveal the presence of the moth. Several of the woodland colonies are exterminated, while in others but a few caterpillars were found. In each of two colonies in which there were found respectively 1,941 and 2,988 caterpillars in 1898, no form of the moth was found in 1899. This town has been entirely inspected or burlapped during the past year, and is now in excellent condition for exterminative work.

Summary.

The statement of the condition of the infested cities and towns is based upon data obtained from a personal examination of all the important colonies, supplemented by a considerable amount of inspection (and in many cases re-inspection) by expert employees, working independently of the general force. That the entire infested district was never so free from the gypsy moth since the beginning of the State work as at present is evident from facts which all may obtain. It is fortunate that the evidence showing the relative scarcity or abundance of the gypsy moth is of a physical nature, and may be apprehended by a reasonable exercise of the senses. Serious devastation by the caterpillars cannot pass unnoticed, neither can the masses of egg-clusters — the natural result of the insect's increase — remain concealed. Should critics of this work pay more attention to this simple principle, much misinformation and misrepresentation would be avoided. The condition of the infested region in past years is well

known to the residents of the district. The swarming hordes of caterpillars, the widespread devastation, the trees felted with thousands of egg-clusters, have not been forgotten. To-day we invite the most critical examination of the region occupied by the gypsy moth, feeling confident that the result of our work, as shown by the present scarcity of egg-clusters, is the best evidence of its success.

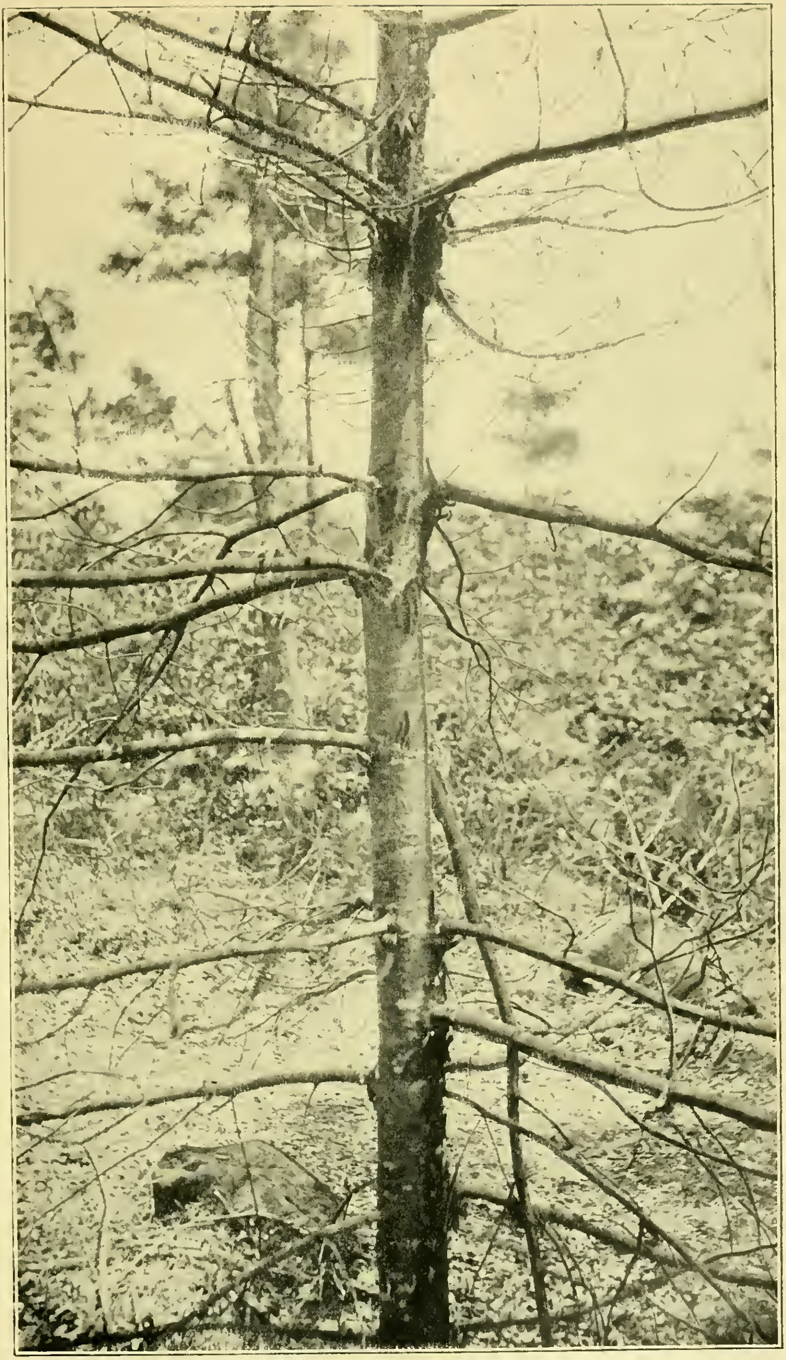
Of the cities and towns in the preceding list, twelve are now in a condition where exterminative measures can be at once prosecuted to advantage. Of the remaining, at least thirteen should be inspected before the hatching period. If this can be done, doubtless several of these will be found so free from the moth that they may be added to the list of those ready for exterminative work. In Beverly, Danvers, Brighton and Charlestown, places formerly infested, no form of the moth has been found during 1899. In a number of towns there is necessary a large amount of preliminary work, such as cutting of trees and brush and the closing of cavities in infested trees. This can be done from time to time, as opportunities present. Should suitable funds be made available early in the year, the work of inspection will be carried on when the weather permits. At other times the force will be utilized in cutting brush, thinning infested woodlands, putting trees in condition for burlapping, and treating egg-clusters in residential and woodland colonies.

The work against the gypsy moth is now at a point where the vigorous prosecution of exterminative measures is a necessity, if the desired end is to be gained. The infestations in the majority of the thirty-four cities and towns are small, but somewhat numerous and widely scattered. When they are stamped out, the moth will be exterminated. If they are neglected, the moth will increase and spread. The danger of reinfestation of cleared areas is not an unimportant matter. When the Salem and Saugus colonies were neglected, Marblehead and Nahant became reinfested. There is also the greater danger of the increase of the known colonies. When the infested woodland district in Malden, Medford and Winchester was neglected, the infested area in these towns was soon enlarged ten-fold, and the expense of the necessary work in this district proportionately increased.

Reduced and delayed appropriations result only in the neglect of a part of the necessary work, the loss of ground gained, and the undesirable and dangerous prolongation of the whole undertaking. While the writer's opinion is entitled to such weight only as his entomological training and experience in the work warrant, he firmly believes that, if the final stages of the attempt to exterminate the gypsy moth cannot receive the prompt and liberal support of the Legislature, the whole undertaking should be abandoned.

For the Consideration of Tax Payers.

The establishment of the imported gypsy moth in Massachusetts involves an important question of public policy. While there are doubtless individuals who do not believe that the moth is a serious pest, such are not to be found among those who have seen or suffered from the unrestricted ravages of the insect. The limitations of inexperience, popular ignorance or indifference are conspicuously evident in those most skeptical of the insect's power for harm; on the other hand, hundreds of intelligent citizens in eastern Massachusetts have a knowledge born of disastrous experience with the uncontrolled increase of the gypsy moth. That the pressure of public opinion was strong enough to induce the State to begin the work of extermination is sufficient evidence of the insect's ability to cause severe and widespread devastation. Granting, then, that the gypsy moth is a serious foe to our agricultural interests, as well as to our forests, parks and shade trees, and that it exists in a restricted area, it is evident that its control and extermination are at once desirable and necessary. Theoretically, this end may be obtained in two ways; (1) by the co-operation of all owners of infested estates; (2) by action on the part of the State. The abstract proposition, whether the moth can be controlled by individuals, is not difficult of solution in the light of comparatively recent history. This system of fighting the moth was thoroughly tested by property owners in Medford during the years 1888–90. In the time which had elapsed since the unfortunate introduction of the insect in 1869 the moth had become acclimatized and disseminated over an area many miles in



Gypsy moth caterpillars clustered on a defoliated pine.

diameter. In the period mentioned its ravages assumed a most formidable character, and fruit and shade trees were devastated by millions of hungry insects. The control of the insect was practically delegated, by common consent, to the efforts of the individual property owners. Each energetic sufferer attempted, by the outlay of time and money, to destroy the caterpillars which swarmed over his property; each shiftless neighbor allowed the insects to multiply and run riot over his place, thus setting at naught the efforts of the more enterprising members of the community. This state of affairs continued to grow worse, until in midsummer, 1889, the town, and later, in 1890, the State was called upon for aid. What warrant have we to believe that similar conditions would not in a few years follow the abandonment of the work against the gypsy moth? We know that the moth has lost none of its prolificacy or voracity, — witness the recent colony at Georgetown, illustrations from which appear in this report. Has human nature so changed that all members of an afflicted community would now work together to control this pest? That they would not is evident from past experience. As a matter of fact, they could not if they would, because of the great expense involved in such an undertaking.

The test of a method is the result obtained. Individual efforts under the prevailing conditions of society were not successful in coping with the moth. Has the work against the gypsy moth under State auspices been a success? The answer to this question may be fairly sought in a contrast of the conditions prevailing at the inception of the work and those that obtain at the present time. When the State work against the moth began, the foliage of the trees in a large part of Medford and in parts of Arlington and Malden had been destroyed, and, as a result of the devastation in previous years, hundreds of trees were dying or dead. Serious outbreaks soon appeared at Swampscott and other places along the north shore. Large colonies of the moth developed in the woodlands near the infested district, while the pest was known to be disseminated in varying numbers through at least thirty cities and towns. At the present time damage by the moth has been brought down to a minimum,

defoliation of trees is of rare occurrence, the large colonies have been reduced, hundreds of smaller colonies exterminated, and the increase of the pest controlled and checked. It is true that during the years 1894–96 a large and formidable multiplication in the numbers of the moth took place in the woodland colonies; but this, as has been repeatedly pointed out in previous reports, was due to the diminished appropriations of those years, which prevented the destruction of the moth in such localities. During the past two years, however, with more liberal appropriations, the lost ground has been regained, and a noticeable and gratifying reduction of the moth throughout the entire infested district has been secured. Thus the success of the work of the State against the moth finds a complete demonstration in the conditions which exist to-day in the infested territory.

This brings us to the counting of the cost. If the sum needed for the operations of 1900 be made available promptly, it can be well expended in persistent, thorough-going work over the entire infested district, — an effort whose effectiveness and importance will be at once apparent. The infestation now consists of many small, scattered colonies, for whose extermination a large amount of skilled labor will be required. Trained labor commands a somewhat higher price than the untrained; and thus in the final stages of the work the relative expense for the number of moths destroyed will be somewhat larger than in the earlier years, where the greater proportion of labor was utilized in the wholesale killing of the moths.

Concerning the damage the moth would cause should it become disseminated over the State, the estimate of Professor Fernald, $1,000,000 per annum, seems to the writer to be sufficiently conservative. This loss will fall with the greatest force upon the farming class. It will affect the owners of shade and ornamental trees and shrubs. Municipalities will suffer through the devastation of the trees in parks and along the streets. The burden will also be felt locally in the increased price of agricultural products in those regions where damage by the moth is greatest.

The problem of the relation of the gypsy moth to the prop-

erty interests of the citizens of the State is, then, not difficult of a logical solution. We are menaced by a dangerous, imported pest. Where individuals and municipalities have failed, the State has succeeded in controlling the spread and ravages of the moth. To finish the work, liberal appropriations will be necessary for the next few years. On the other hand, should the work cease, the spread of the moth over the State will follow, resulting in annual damage to the amount of at least a million dollars. Reason and good business judgment alike would seem to indicate the desirability of continuing the State work against the insect, without unnecessary delays and with the most vigorous measures possible.

A. H. KIRKLAND.

REPORT ON THE BROWN-TAIL MOTH.

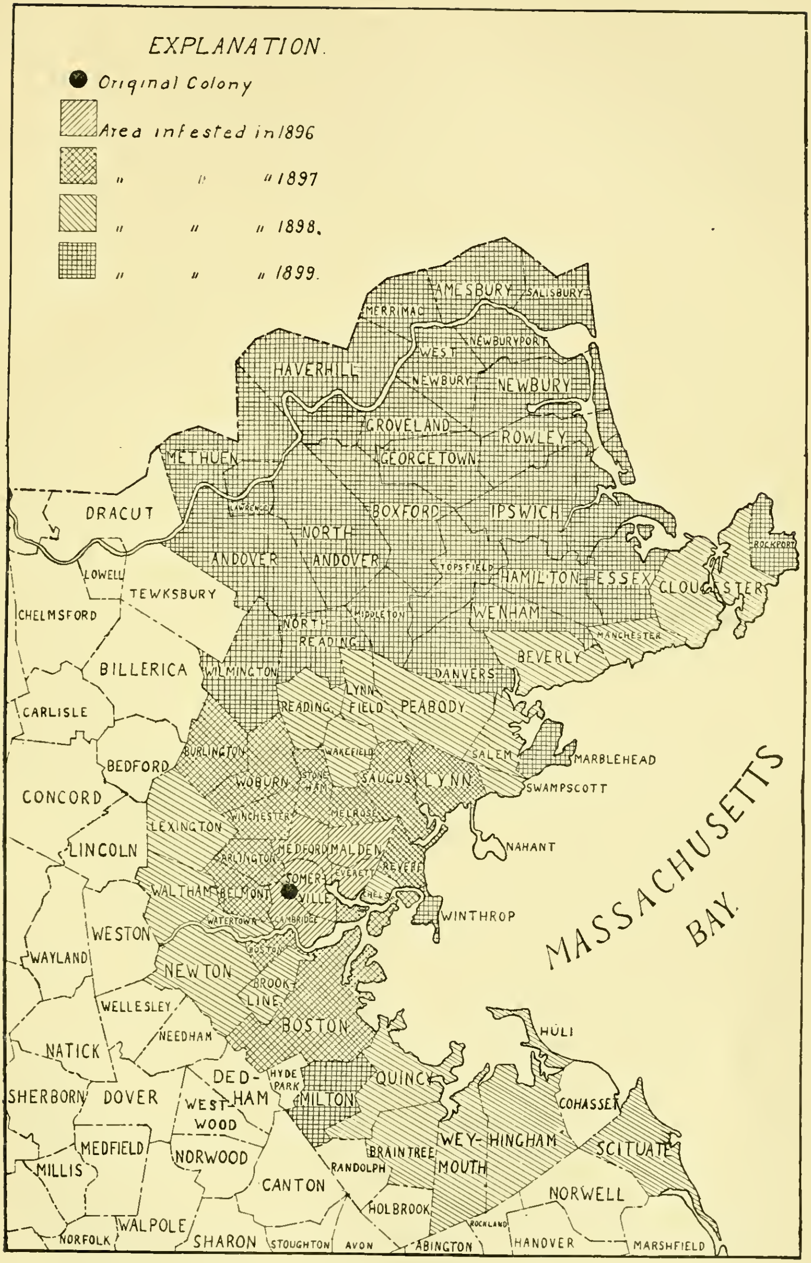
To the Massachusetts State Board of Agriculture.

While the same employees that are engaged in combating the gypsy moth carry on the work against the brown-tail moth, the wide difference in the habits of the insects and in the methods of destroying them renders it advisable to make a separate report on this part of our work, in order that there may be no confusion of the subjects treated.

By the action of the Legislature in 1898 the work of combating the brown-tail moth was placed in charge of the Board of Agriculture, and $10,000 of the sum previously appropriated for work against the gypsy moth was set aside for use against the brown-tail moth. Similar action in regard to the appropriation was taken by the Legislature of 1899.

An examination of the region occupied by this insect, completed in December, 1898, showed that the brown-tail moth was then disseminated throughout an area extending at least from Gloucester to Scituate, and westward as far as Waltham. This area has greatly enlarged during the past year. The rapidly increasing distribution of this insect is well shown by the accompanying map. As the female moth flies vigorously and is often carried long distances by the wind, there is every reason to expect that notwithstanding the efforts now made to control it, in a short time this insect will become widely disseminated.

While your committee is willing to accept the responsibility placed upon it by the Legislature, it holds that expenditures of public funds in combating insect pests are scarcely justifiable in those cases where the extermination or control of the pest is an obvious impossibility. The possibility of exterminating the gypsy moth has been repeatedly and convincingly demonstrated by the complete eradication of hundreds of colonies under the most difficult conditions. On the other



Map showing the rapidly increasing spread of the brown-tail moth.

hand, no colony of the brown-tail moth since the insect became well established has yet been exterminated. Cities like Cambridge and Somerville, cleared of this pest in 1898, have been reinfested through the actively flying female moths. In the three years in which the brown-tail moth has been known as a pest in this country it has become distributed over nearly four times the area occupied by the gypsy moth in thirty years. If a part of the funds requested and needed for work against the gypsy moth are to be annually set apart for the destruction of the brown-tail moth, neither undertaking can be brought to a successful conclusion. Your committee is willing to continue the direction of the work against the brown-tail moth if the Legislature so indicates its desire by making a separate appropriation for the purpose. In justice to itself, however, it feels obliged to register a protest against continued expenditures in a work whose impossibility is patent, while the extermination of the gypsy moth, whose entire possibility has been thoroughly demonstrated, suffers from inadequate financial support.

The following is the statement of expenditures made in combating the brown-tail moth: —

Financial Statement for 1899, — Brown-tail Moth.

Balance on hand Jan. 1, 1899,		$1 04
Appropriation for the year 1899,		10,000 00
		$10,001 04
Wages of employees,	$9,999 81	
Balance on hand Jan. 1, 1900,	1 23	
		$10,001 04

E. W. WOOD.
AUGUSTUS PRATT.
F. W. SARGENT.
N. I. BOWDITCH.
JOHN M. DANFORTH.
J. W. STOCKWELL.

Report of Acting Field Director.

To the Committee on the Gypsy Moth.

The act making an appropriation of $170,000 for the gypsy moth work in 1899 set aside a sum not to exceed $10,000 for use in the destruction of the brown-tail moth. This sum was expended as follows: in April the webs in the worst-infested localities in Malden were cut off and destroyed; in June several localities in Medford and Malden, where the caterpillars were destructively abundant, were sprayed with arsenate of lead with good results. These outbreaks were sufficiently severe to cause much annoyance and considerable damage. Late in November the larger part of the webs in Medford, Malden and Everett was destroyed. Since it was useless to attempt to exterminate this insect from any one of the cities with the sum at that time available (about $6,000), it was deemed wiser to destroy the large masses of larvæ, and in this way, so far as possible, prevent serious damage by the insect in 1900. It did not seem wise to spend time and money in removing the scattered webs from the tops of tall elms, for example, while near at hand on infested pear and apple trees there were thousands of webs from which the following year the insects would develop in great swarms. It thus follows that the work against the brown-tail moth has been merely an attempt at local control, rather than at extermination.

Work Done.

Trees inspected,	413,758
Trees sprayed,	2,517
Trees cut,	4
Trees trimmed,	4
Winter webs destroyed (old),	13,519
Winter webs destroyed (new),	884,480

In order to work intelligently in the matter, it seemed important to determine the area over which the moth had

become distributed. To this end, late in December, 1898, several employees were sent on trips of inspection through towns bordering on the known infested region. As a result, the infested area was found to be nearly double that which had been known. In brief, the moth was found to be disseminated from Gloucester on the north to Scituate on the south, and as far west as Waltham. In November and December, 1899, an examination of the towns lying outside of the region known to be infested in 1898 gave even more discouraging results. The moth is now known to be disseminated throughout the north shore district, above Cape Ann, and even over the State line in New Hampshire. A tabulation by years of the towns infested is given below: —

1896.

Cambridge.
Everett.
Malden.
Medford.
Somerville.

1897.

Arlington.
Belmont.
Boston.
Burlington.
Lynn.
Melrose.
Revere.
Saugus.
Stoneham.
Winchester.
Woburn.

1898.

Beverly.
Braintree.
Brookline.
Chelsea.
Gloucester.
Hingham.
Hull.
Lexington.
Lynnfield.
Manchester.
Newton.
Peabody.
Quincy.
Reading.
Salem.
Scituate.
Swampscott.
Wakefield
Waltham.
Watertown.
Weymouth.

1899.

Amesbury.
Andover.
Boxford
Danvers.
Georgetown.
Groveland.
Hamilton.
Haverhill.
Ipswich.
Lawrence.
Marblehead.
Merrimac.
Methuen.
Middleton.
Milton.
Newbury.
Newburyport.
North Andover.
North Reading.
Rockport.
Rowley.
Salisbury.
Topsfield.
Wenham.
West Newbury.
Wilmington.
Winthrop.

Seabrook, N. H.

The map given in another part of this report makes clearer than words the exact situation. Should the brown-tail moth continue its present rate of spread, its dissemination over the

State will be a matter of only a few decades. The figures given below are significant: —

	Sq. Miles.
Area infested, fall of 1896,	29
Area infested, fall of 1897,	158
Area infested, fall of 1898,	448
Area infested, fall of 1899,	928

The areas given in the above table are those of the cities and towns in which the winter webs of the moth for the respective years were found. When the moth was first noticed in May, 1897, the winter webs of 1896 were still visible, and indicated the area occupied by the insect that year. The figures given in the above table make evident the hopelessness of attempting to exterminate the brown-tail moth. In fact, the co-operation of Massachusetts and New Hampshire would now be necessary as the first step in an attempt toward extermination. The destruction of large masses of the insect tends to check its spread, and it is possible that the attempt to secure its control may be carried on as at present under State auspices more economically than by miscellaneous undirected individual efforts.

It cannot be doubted that we are soon to see the general distribution of this insect over the Commonwealth; and in view of the approach of this unfortunate condition, it would seem wise to provide for the publication and distribution among the citizens of the State of a carefully prepared report, which shall set forth the habits of the insect and the various remedies best suited to insure its destruction.

A. H. KIRKLAND.

NINTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED

UNDER CHAPTER 412, ACTS OF 1891.

JANUARY 15, 1900.

Dairy Bureau—1899-1900.

D. A. HORTON, Northampton, *Chairman.*

J. L. ELLSWORTH, Worcester.

C. D. RICHARDSON, West Brookfield.

Executive Officer.

J. W. STOCKWELL, *Secretary of the State Board of Agriculture.*

Assistant to the Secretary and Acting Executive Officer, appointed by the Governor.

GEO. M. WHITAKER, Boston.

REPORT OF THE DAIRY BUREAU.

The Dairy Bureau is charged with the enforcement of the dairy laws of the Commonwealth, and also with educational work. In enforcing these laws the Bureau has co-ordinate jurisdiction with the State Board of Health and with milk inspectors, and at first glance it would seem as if there were an unnecessary complexity of machinery; but this is apparent rather than real. So far as the State Board of Health concerns itself with dairy products, it makes a specialty of looking for violations of the milk laws; consequently, the Dairy Bureau makes a specialty of enforcing the counterfeit butter laws. In most cities and towns having milk inspectors the salaries paid these officers are very small, hence no great amount of work is performed by them, and there is need of inspection by State officers; in these places we are welcomed, sometimes very heartily, as an important ally of the local authorities. Boston, however, has liberal appropriations, and in Dr. Harrington an excellent officer to enforce the law; therefore the work is well done, and we attempt nothing in the city of Boston. From the above it will be seen that, in enforcing the laws relative to counterfeit butter outside of Boston, with incidental attention to other dairy laws, and in carrying out the injunction of the statute "to disseminate such information as shall be of service in producing a more uniform dairy product of higher grade and better quality," the Dairy Bureau has a distinctive field of action different from that of any other department, and one in which there is an abundance of important work.

During the past year we have been exceptionally busy, and have accomplished more — at least, so far as visible and statistical results show — than in any previous year of the Bureau's existence. This is largely due to increased activity of dealers in oleomargarine, and the addition to our work

by the passage of the renovated butter law last winter. We have made more than the average number of inspections, taken more samples than in previous years, had more than the average number of cases in court, secured more convictions than ever before, and have done an unusual amount of educational work. This has necessarily increased our expenses for travel and chemist's services, but the expense for agents' salaries has been below the average. Notwithstanding all that has been accomplished, we have seen much more that could be done which we were obliged to leave untouched, on account of the limited appropriation. With more money we could have shown even greater results.

The membership of the Bureau has remained the same as last year. There has been a change, however, in the executive officer, due to the retirement of Hon. William R. Sessions, who declined another re-election as secretary of the Board of Agriculture. Hon. J. W. Stockwell was elected in January, and in July assumed the office, which includes the position of executive officer of the Bureau. The details of the executive work have continued under the direction of George M. Whitaker, who in September was reappointed by the Governor as "assistant to the secretary of the Board of Agriculture . . . to assist in the work prescribed in the eleventh section of this act."

Only two regular agents for collecting samples and for inspection service have been at work during the year. Mr. Stockwell resigned in January, and Ralph M. Horton was then employed as a regular agent. George F. Baldwin has been continued during the year. Prof. F. S. Cooley of the Agricultural College was appointed in the summer as a temporary agent to investigate the work of the creameries of the State. From time to time special agents have been employed for short terms, as circumstances seemed to demand. The regular agents become in time so well known that their efficiency for detective work is in some instances impaired, and good results occasionally follow the temporary employment of a person unknown to would-be law breakers.

The chemical work during the year has been performed by Dr. B. F. Davenport and by the Hatch Experiment Station (Edward B. Holland, analyst), the former analyzing

samples taken in the eastern part of the State, and the latter samples taken in the western part of the State.

In a general way and statistically the work of the Bureau during the year has been as follows: —

Inspection of places in which dairy products or imitation dairy products were sold or stored,	1,935
Samples taken of real or imitation butter,	742
Samples taken of milk,	611
Samples taken of condensed milk,	102
Samples taken of cream,	4
Cases in court,	87
Meetings addressed, including a butter exhibition,	19
Inspection of creameries.	
Work at fairs.	

The offences charged in the court cases have been as follows: —

Having milk of less than standard quality in possession with intent to sell,	19
Having imitation of yellow butter in possession with intent to sell,	47
Serving oleomargarine in hotels and restaurants without giving notice,	13
Obstructing officers in prosecution of their work,	3
Condensed milk,	5
Total,	87

This does not include all of the work done, as evidence has been secured of several violations of the law which could not be tried during the year, and necessarily went over to the next year's record. Evidence in two other cases which could not be tried on account of the absconding of the defendants was secured.

Of the above 87 cases in court, the defendant was acquitted in 10 and a *nol pros.* entered in 7, leaving the largest number of convictions secured by the Bureau in any one year.

A more detailed account of the work is as follows: —

Imitation Butter.

Natural butter has been higher in price during the past year than for a number of previous years, which has been a temptation to crowd the sales of the spurious article. Fur-

ther than that, the number of manufacturers who have been pushing their goods in Massachusetts has increased. When the national supreme court rendered its now famous Plumley decision, sustaining the constitutionality of the anti-color law, the large Chicago manufacturers withdrew from Massachusetts. They said that, whatever might be their opinion of the law, they could not afford to stand before the community as law breakers. As a result of this decision, all of the counterfeit butter that came into Massachusetts for several years was made in Rhode Island, by companies bearing the names — somewhat peculiar for the business in which they were engaged — of "Vermont" and "Oakdale." During the past year the greed of gain has led two large Chicago manufacturers to climb sheepishly down from the pedestal of virtue on which they had been posing, and enter the scramble for dollars by defying the laws of the Commonwealth. These large manufacturers have made cities and towns in other States near the Massachusetts line the base of their operations, and in many instances have resorted to tricks that would bring a blush of envy to the average kitchen bar room proprietor.

On these accounts we have had no lack of work. Our agents have travelled more miles, made more inspections and procured more evidence than in any previous year.

We have had 63 cases in court. Evidence has also been secured in a number of others which it was impossible to try in time to go into the year's records. The charges were as follows: —

Violating the anti-color law,	47
Violating the hotel-restaurant law,	13
Obstructing an officer,	3
Total,	63

It will be noticed that only two forms of complaint have been used. Some years we have brought charges for violating as many as eight different laws, but in every case the anti-color law was one of the number which was violated. As courts do not like to multiply cases based on a single transaction, and as violation of the anti-color law is easily proved, we have adopted the practice of making all complaints for the

violation of that law, except when oleomargarine is served in hotels and restaurants without giving notice.

In the above 60 oleomargarine cases, 2 were *nol prossed* and there were 5 acquittals, leaving convictions in 55 cases, as against 16 in 1898 and 21 in 1897. No cases appealed to the superior court have been lost. Exceptions have been saved for the supreme court on three points. In a majority of cases where the anti-color law was violated the oleomargarine was sold as and for butter, so that there was a commercial and moral fraud, as well as a violation of the statute. In one case we found the marks and brands required by the national government erased from the tub, and in place thereof the stencil "From J. D. Smith's Creamery, Sudbury, Vermont." An inspector was sent to Sudbury to investigate, and found no such creamery in the place.

Though the sale of oleomargarine has been pushed harder than ever before in the State, the law has been enforced with such efficiency that the veteran market reporter of one of the leading daily papers of Boston, who is remarkably well informed, in summing up the situation says: "Although oleomargarine seems to be interfering considerably with the consumption of genuine butter in the west, we do not think it cuts much of a figure here."

In a number of instances our agents have found shipments of oleomargarine in transit, and following it to the place of delivery have traced it to some State institution, in one case to a soldiers' home. Thus in many instances the State is holding out temptation to law breakers, and giving a counterfeit article to the unfortunate inmates of our eleemosynary institutions, not excepting the veterans who risked their lives in the defence of their country.

Dr. Harrington, the Boston milk inspector, for several months prosecuted restaurant keepers for the sale of an imitation of yellow butter; but after awhile he ran against a snag in the person of a judge who held that complaints ought not to be brought under that act, because restaurant keepers are especially mentioned in another, and discharged the defendant. Acting on what he believed to be good advice, the inspector entered more cases under slightly different pleadings, got convictions, and the defendants appealed to

the superior court. One case was called in May, and the judge, on consultation with counsel on both sides and such of his associates as could be seen, decided that furnishing yellow oleomargarine to be used on bread as a part of a meal does not constitute a sale of the oleomargarine in the same sense that furnishing milk as a part of a meal constitutes a sale of milk. The minimum fine in the restaurant cases is only $10, while in the other class of cases it is $100.

We yet hear occasional criticisms of the anti-color law, especially by persons who have not had opportunity to investigate it; and the remark is sometimes made that, if butter can be colored, there is no good reason why oleomargarine cannot be sold in imitation of butter. This is sophistical. Admitting, for argument's sake, that coloring butter is indefensible, it does not make right the selling of a counterfeit. As has been frequently explained in previous reports, the law is demanded in the interests of commercial honesty. Colored oleomargarine is a fraudulent article; when sold, it is usually sold dishonestly, and not only sold dishonestly, but at an exorbitant profit. Experience has proved this. In instances where we have found it on sale, where people had taken their chances in violating the law, we have found the retailer getting a profit of 60 or 70 per cent, to say nothing of the swindle of palming off lard and tallow on persons who supposed they were getting real butter. Such cases would be multiplied enormously and indefinitely, were it not for this law. Hence the law is in the interests of consumer, producer and dealer in honest butter.

During the year an attempt has been made in a number of States to create a sentiment in favor of increasing the national revenue tax on colored oleomargarine, in order still further to throttle a counterfeit. It has been shown that this might endanger the constitutionality of the anti-color law by recognizing colored oleomargarine as an article of commerce, should the supreme court follow the logic of the recent Pennsylvania case. In view of this fact, an effort is to be made first to secure a law in relation to food products similar to what has already been enacted in relation to intoxicating liquors, — to wit, that food products, especially dairy articles, shall be subject to the laws of the States into which they are imported. This will clinch the question of constitutionality.

Then can follow an increase in the tax on colored oleomargarine, which will not jeopardize any legislation which has been already secured.

There have been no court decisions during the past year of particular importance. In Michigan the anti-color law has been temporarily defeated on a technical ground, the claim being that the subject of the statute was not indicated with sufficient clearness in the title.

Renovated Butter.

The process of gathering up low grades and refuse butter, and so renovating the mass as to produce a clean, palatable article, is in the abstract a gain to humanity, as is any process that economizes wastes, utilizes by-products and perfects or increases the world's food supply; but when avarice impels weak mankind to sell the product dishonestly, when this clarified stuff is in many cases given to the consumer as fresh creamery butter, law is necessary to protect consumer, honest dealer and the better class of producers. Such a state of affairs existed in Pennsylvania, New York, Minnesota and Massachusetts last winter, to such an extent as to lead to the enactment of laws requiring that packages and wrappers used in the sale of this grade of butter should be marked with the words "Renovated Butter." This condition of affairs and this law has added to our work and expenses, especially for chemists' analyses; but we cannot report any absolute statistics on this point, because the work is closely related to the enforcement of the oleomargarine laws. When an inspector visits a store, he is on the lookout for both oleomargarine and renovated butter. Still further, they are often so near alike in superficial characteristics that he recognizes what he finds as something that is not natural butter, and takes a sample, a chemical analysis being necessary to detect the nature of the substance.

During the year we have found no wilful violations of the law. Where the goods have been found unmarked, attention has been called to the fact, and in every instance so far there has seemingly been a willingness to comply with the law; hence there have been no prosecutions. In a few instances there has appeared an attempt to evade the law by having the mark or brand less distinct than the law required.

One dealer used wrappers marked "Sterilized Renovated Butter."

It goes without saying that the law is unpopular with would-be or actual dealers in this kind of butter. This unpopularity has been increased this season by the high price of butter, which has stimulated the demand for the lower grades, and, as one market reporter says, has proved "a bonanza for dealers in renovated butter." Why a bonanza, unless because they were selling at abnormal profits, and inferentially dishonestly? The objection is to the word "renovated," which is said to carry a stigma, and to be a derogatory expression which injures the sale of this butter. Dealers prefer the word "sterilized;" but "renovated" is an honest appellation, while "sterilized" is not.

Butter.

The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for five years: —

	1899. Cents.	1898. Cents.	1897. Cents.	1896. Cents.	1895. Cents.
January,	21	22½	22	26	26
February,	24	21½	22	24	25
March,	22½	22	23	24	23
April,	21	22½	22	22	21
May,	19	18	18	17	19
June,	19	17½	16	16½	20
July,	19	18½	16½	16½	19
August,	21½	19½	19	17½	21
September,	23½	21	22	17½	22
October,	24	21½	22½	20	23
November,	26½	21	22	21	23
December,	28	21	23	23	28
Average,	22.4	20.5	20.6	20.4	22.5

While the price during some months was below the average for corresponding months, the average for the year 1899 was about two cents per pound more than the average of 1896, 1897 and 1898. The advance was most marked during the last five months of the year.

The amount of business done in Boston for the years 1899 and 1898 was as follows: —

	1899. Pounds.	1898. Pounds.
On hand January 1,	2,829,160	2,474,000
Receipts for year,	49,457,606	50,609,552
Total supply,	52,286,766	53,083,552
Exports, deduct	2,951,710	1,574,682
Net supply,	49,335,056	51,508,870
Stock December 31, deduct	2,035,400	2,829,160
Consumption,	47,299,656	48,679,710

The average monthly consumption for three years has been as follows: —

	Pounds.
1899,	3,933,300
1898,	4,056,600
1897,	4,021,500

It is unfortunate that statistics for other cities are not available; but in no other place in the State is there any organized body which looks after the statistics of business so carefully as the Boston Chamber of Commerce.

If the existence of the oleomargarine laws and the way that they are enforced has driven out of the business a dishonest substitute and increased sales of genuine butter by an amount equal to one per cent of the consumption reported above for Boston alone, we have the value of the law to consumers, producers and dealers, expressed in pounds, as 470,000. This we believe to be an extremely conservative estimate. We base our opinion on the temptation there is to sell colored oleomargarine dishonestly, and the great amount that

would flood the market were there no laws in existence. If this 470,000 pounds is valued at the average price for the past year of 22.4 cents, we have $105,280 to the credit of the law and its execution; but if we have exaggerated to the great extent of doubling the amount, the figures $52,000 would still show a material saving.

Samples of butter have been submitted to this department during the past year which have had amounts of moisture varying from 7 to 33 per cent. These are extreme, and yet the samples of butter were taken from goods in possession of dealers in the ordinary course of commerce, and show what is possible. Analyses of many samples of butter show that the usual amount of moisture is from 15 to 20 per cent. When butter contains an abnormal amount of water, it appears to us to be a case of adulteration so far as the moral aspects of the case go, even though there is no violation of any statute.

Massachusetts Creameries.

It is difficult to get at the exact number of creameries in the State, as in a number of cases city milk dealers have a butter plant for working up their surplus milk, and it is a question whether such an establishment can be fairly called a creamery. Furthermore, in several cases where creameries have been built business has been suspended temporarily, but with a possibility of revival.

We estimate that there are 46 butter factories in the State. Thirty-three of these, mostly co-operative, reported to the agent of the Bureau, Professor Cooley, that in 1898 they made 3,750,000 pounds of butter and sold 110,000 gallons of cream. The raw material was received from 2,700 farmers, who represented 23,000 cows. The value of the product was $842,000.

Of these co-operative creameries 5 were incorporated as far back as 1886, but the average age of those now in existence is only nine years. Most of these that have gone out of existence — West Dudley, Rutland, Leominster, Ipswich, Hampden and others — have been forced out from the competition of the sale milk business. The value of milk to sell as milk is usually in excess of its butter value; and where creameries have been located near large towns or along the

lines of railroads where milk cars run to Boston, farmers have gradually withdrawn from the creamery and gone to selling milk, except in a few instances where the creamery has turned its attention to the production of cream rather than of butter. Generally speaking, the majority of the creameries are strong and in good condition, increasing their output.

The newer creameries do not always represent new business, but a transfer of a part of the business of some older creamery. The relative rank of the first 12 creameries as to value of output is as follows: Conway, Amherst, Belchertown, Hampton, Cummington, Chester, Egremont, Charlemont, Northfield, Williamsburg, Greylock and Ashfield.

The troubles from the surplus in the sale milk business in Boston have been emphasized and become prominent through the magnitude of the business, leading to a considerable discussion of the problem in the agricultural press. But the creameries of the State are troubled in a similar way, though not so emphatically. The amount of production varies very much from month to month. Ten of the leading creameries show a maximum production in June of 177,000 pounds of butter and a minimum in September of 120,000 pounds, — a variation of 57,000 pounds in four months. This is a shrinkage from the heaviest production of 32 per cent, and presents the same problem of uneven supply that troubles the Boston milk market. Either there was a surplus of 57,000 pounds in June and nearly the same in May, or there was a shortage in the supply of that amount in August and September, and of almost that amount in November and February. Several creameries who have regular customers and keep well sold up have been obliged to buy butter from Vermont or New York to supply their customers when the home supply was short.

The conditions of individual creameries are even worse than this average. The Egremont creamery produced in June 27,000 pounds of butter and in February 11,000,—a difference of 60 per cent, or 16,000 pounds. Belchertown produced 29,000 pounds in June and 17,000 in December, — a difference of 12,000 pounds, or 43 per cent. Ashfield's percentage of difference is 52, though, as the creamery was doing a smaller business, the variation was only about 8,000 pounds.

An attempt was made to get at the annual butter yield per cow, in which there is an element of uncertainty on account of the varying number of cows that supply a creamery during the year, but the result obtained may be regarded as approximately correct; it is an average of 175 pounds. The highest return was made by Williamstown and Egremont creameries, 204 pounds each; and the lowest by Hinsdale, 127 pounds. Estimating the value of butter at 19 cents per pound, the income per cow varied from $24.13 in the case of Hinsdale creamery to $38.76 in the case of Williamstown and Egremont.

This showing of 175 pounds of butter per cow is very creditable to Massachusetts dairymen, when looked at from the stand-point of the fact that the census of 1885 makes the estimate that 130 pounds is the average for the country. On the other hand, it should be remembered that many dairies average 300 pounds per cow, and more is not of infrequent occurrence. In the competition under the auspices of the Guernsey Cattle Club the herd of George C. Hill & Son at Rosendale, Wis., averged 455 pounds of butter per cow for the year; and that of L. P. Morton, Rhinecliffe, N. Y., averaged 450 pounds. Such variations — from 455 to 127 pounds of butter per cow per year — would be hardly possible in any other kind of manufacturing.

About 90 per cent of the butter produced in Massachusetts creameries is marketed in cities and towns comparatively near the creamery, and does not come into the large wholesale markets. The balance is sent to Boston and New York, and is quite largely the surplus in seasons of largest amounts made. About 85 per cent of the butter manufactured is wrapped in prints, and about 5 per cent put into five-pound boxes, showing that 90 per cent, or approximately about the same as is sold near home, is for immediate consumption.

At creamery institutes there is a general desire for some mode of inspection of dairies, because poor cream from one dairy will seriously affect the whole churning, and injure the returns to every farmer supplying that creamery with cream. But there are so many different ideas among the different creameries as to the methods to be pursued, that Professor Cooley recommended that no general inspection be attempted,

but that the Dairy Bureau secure the services of an expert, who can be called upon by creameries if wanted.

The Belchertown creamery scores dairies by a scale of points, and the following is suggested, which would also be a good scale in scoring dairies producing sale milk (on a scale of 100, 50 points are allowed for care of cows and 50 for the handling of milk) : —

Scale of Points for inspecting Dairies.

	Perfect.
Condition of cows, health,	6
Cleanliness,	6
Stables, clean,	4
Light,	5
Good ventilation,	5
Disinfected twice a year,	4
Yards, dry,	5
Feed,	10
Water,	5
Care of milk : —	
Handling, straining,	6
Submerging,	6
Apparatus, thoroughly washed,	4
Scalded,	4
Exposed to sunlight,	4
Location of cream room, dry,	2
Free from odor,	4
Ventilation,	3
Care of tank, clean,	3
Pure water,	7
Temperature,	7
	100

Of the creameries investigated, 86.5 per cent use the Cooley creamer and 13.5 per cent the various separators.

Nearly 60 per cent of the cream is taken by gatherers, who make a trip every other day. Almost half of the remainder is collected four times a week.

Of the by-product, buttermilk, 82 per cent is used for feeding pigs and calves and 11 per cent is sold for domestic consumption.

Milk.

In the enforcement of the milk law we have taken 611 samples. In 19 instances the milk was so poor as to warrant prosecution. In 3 cases the defendant was discharged

on technical grounds growing out of last winter's law, leaving 16 convictions.

The result of the analyses of the milk in the 19 cases was as follows: —

	Solids not Fat (Per Cent).	Fat (Per Cent).	Total Solids (Per Cent).
No. 1,	8.29	3.05	11.34
No. 2,	8.53	2.80	11.33
No. 3,	8.64	3.05	11.69
No. 4,	7.29	3.60	10.89
No. 5,	10.24	.40	10.64
No. 6,	9.84	2.06	11.90
No. 7,	8.80	2.24	11.04
No. 8,	8.58	2.80	11.38
No 9,	8.62	2.80	11.42
No. 10,	8.82	2.54	11.36
No. 11,	9.36	2.62	11.98
No. 12,	9.50	2.50	12.00
No. 13,	7.95	3.40	11.35
	8.24	3.40	11.64
No. 14,	7.64	3.13	10.77
No. 15,	7.83	3.33	11.16
No. 16,	8.41	3.00	11.41
	8.79	3.03	11.82
	8.79	3.23	12.02
No. 17,	8.96	2.60	11.56
No. 18,	8.44	1.28	9.72
No. 19,	8.44	2.92	11.36

Last winter's Legislature passed the following law: —

Whenever the state board of health, dairy bureau, or other state or city authority obtains a sample of milk for inspection, by taking, purchase or otherwise, the analysis of said sample shall, within ten days of the procurement thereof, be sent to the person from whom the sample was obtained.

Nothing can be said against the proposition that the producer and distributor of milk should have every possible

opportunity for studying the composition of the product in which he deals and of keeping informed as to its quality. Practical experience, however, shows that in the majority of cases such laws are merely a weapon in the hands of those who would embarrass the enforcement of the law. The law is of no value to the better class of producers and dealers, for the reason that they get none of these notices. In some departments samples taken are submitted to preliminary tests, and only the suspicious ones analyzed; in one department it is held that the law is complied with by sending notices only to those who are to be prosecuted. If, however, the law is to remain on the statute books, the ten-day limit should be modified, as it is so short as to impede the enforcement of the law.

Then, again, there is no agreement as to the meaning of the law. It does not provide, as does chapter 318, section 3, Acts of 1886, that a failure to send the required notice will invalidate proceedings in court; and one judge has held that the law has nothing to do with court practice under the milk laws, and has fined a man when no notice was sent; in another case another judge made an opposite ruling, and discharged the defendant because no notice was sent.

Then, again, there is no agreement among authorities as to how much of an analysis shall be made. The Attorney-General advised us: "The law only requires you to report to the person from whom you took the sample the result of whatever analysis is made by authority of your Board."

A few days after receiving this opinion we took a sample from a dealer, ascertained the amount of total solids, reported the result within ten days, and then complained of him for handling milk not of standard quality. The defence raised the point that merely reporting the amount of the total milk solids was not "reporting the result of an analysis." The judge sustained this view of the case, and discharged the defendant. This judge held that, while the law did not contemplate so complete an analysis as going to the extreme limit, and ascertaining the amount of carbon, oxygen, nitrogen, etc., found in the milk, it did mean that more than one constituent or group of constituents should be ascertained and reported.

Still further, what is the status of a case, if a notice is sent but not received? In most cases we have sent the notice by registered letter. In two instances, however, the letter has been returned, either because the post-office address was incorrect, or because the milkman refused to accept the letter, presuming on its contents.

We can see no benefit from the law; but, if it is to remain, its vagueness should be remedied.

The Legislature of last winter added September to the months during which the statute standard for sale milk should be 12 per cent; in other words, reduced the standard from 13 to 12 per cent during the month of September.

Many years ago the State started on the policy of having a statute standard for milk, and having that standard 13 per cent. Against this statute there has been a constant attack. At length April and May were excepted from its provisions, and the standard made 12 per cent for those two months; Then, after a while, June, July and August were added to the 12 per cent months, and last winter, September.

The argument before the committee for this change was that during September cows are fed largely on corn fodder, which produces milk of inferior quality, so far as total solids are concerned; consequently, it was claimed that the standard should be lowered for September.

If it appears that the policy of the State in establishing the 13 per cent standard was wrong, it would be much better to reverse that policy openly and squarely than to kill it by piecemeal. No one would think of slaughtering an animal by occasionally cutting a few inches off the end of its tail. At any rate, such an unscientific argument as that presented last winter should not be considered. It is well known by all who have studied the question of milk composition that the food of the cow has little to do with the amount of total solids in the milk; that the amount of casein, sugar, fat, etc., in milk depends on the individuality of the animal. A cow born to give 10 per cent milk cannot by any process of feeding be made to give 13 per cent milk.

We are not yet, however, convinced that the State was wrong in the position it took years ago in favor of a 13 per cent standard. Thirteen per cent milk is average milk, and

the majority of cows give milk of that quality. By mixing the milk of different animals, herd milk will be found very uniform in quality, and almost always up to or above the standard. We believe that a 13 per cent statute is in the interest of the consumer, and we also believe that it is in the interest of the producer, for it helps business to the extent that it keeps off from the market all milk below the standard. It seems to us against the interests of the great majority of farmers, and of agriculture generally, that the minority who own cows producing low-grade milk should by their persistency succeed in engrafting their views upon the statute book.

During two weeks of the past year we undertook an investigation of the quality of milk sold for a week before and after the statute standard changed, testing the milk for fat only, by the Babcock tester. The agents of the Bureau were instructed to take samples in Springfield, Somerville, and Chelsea during the last week in September. The first week in October, when the standard had changed to 13 per cent, they were sent over the same territory, to take samples from the same milkmen, so far as was possible. Three or more samples were taken the last week in September and the first week of October from each of 28 milkmen. In 14 cases the milk averaged the same amount of fat in October that it did in September; in 11 instances there was a slightly increased quantity in October, the gain ranging from .4 to .6 of fat. Three cases of adulterated milk were found in October where the milk was all right in September, causing a decrease in the amount of fat.

Stating the case in another way, we took in September, under this experiment, samples as follows: —

CITIES.	Samples.	Average Per Cent of Fat.
Springfield, ...	42	3.50
Somerville, ...	30	3.40
Chelsea, ...	45	3.60
Total, ...	117	3.50

Earlier in the month 27 samples were taken in Williamstown and North Adams, which averaged 3.70 per cent of fat.

The first week in October, samples were taken as follows: —

CITIES.	Samples.	Average Per Cent of Fat.
Springfield,	45	3.70
Somerville,	30	3.60
Chelsea,	45	3.60
Total,	120	3.63

It appears that there was no material increase in the quality of milk when the statute standard changed, on the part of these milkmen, and that both in the last week in September and the first week in October the milk was substantially up to 13 per cent of total solids. So far as this experiment throws any light upon the situation, the average milk that is sold in Massachusetts has 13 per cent total solids in September as well as in October, and the milk sold in September was substantially above the statute standard of 12 per cent total solids.

During the past year, the perplexing conditions of the milk business have led to the organization of the milk peddlers in several places, for purposes of mutual protection. In two cases the assistant executive officer of the Bureau has been called on to address them on the milk law and its operation. In one case 32 samples of milk were tested with the Babcock test before the meeting, as an object lesson on the composition of milk, showing the value of the Babcock tester to dealers in sale milk. The average of these tests was 4.14 per cent of butter fat. Among the samples were two or three which were brought in as suspicious, and brought down the average.

We have made much effort to emphasize the point that the enforcement of the law is of advantage both to peddlers and producers. Very often the milk peddler, accosted by an inspector, particularly in the early morning hours, is

annoyed at the interference, and looks upon the inspector as his natural enemy. This should not be so. The milk laws not only insure the consumer an article of higher quality than he would get were it not for them, but, as said before, they help business by keeping a large amount of low-grade and adulterated milk off the market.

The condition of the Boston milk market has been much healthier than for several years past, as supplies have decreased and consumption has increased. This has reduced the burdensome surplus; for three months of the year it was so small that the wholesalers paid full price for all milk received by them. The advancing price of butter has increased the butter value of milk, so that the diminishing surplus has brought a better price, and this has increased the average return per can.

The following table gives the receipts, sales and surplus of railroad milk, in $8\frac{1}{2}$ quart cans, brought into the greater Boston, as reported by the contractors' association: —

1899.	Received.	Sold.	Surplus.
January,	904,575	699,003	205,572
February,	825,972	631,762	194,210
March,	980,093	699,796	280,297
April,	1,004,773	717,254	287,519
May,	1,160,994	750,592	410,402
June,	1,137,103	792,833	344,270
July,	1,003,661	815,095	188,566
August,	927,433	756,842	170,591
September,	870,140	729,734	140,406
October,	853,049	809,701	43,348
November,	767,567	746,040	21,527
December,	799,404	763,319	36,085
Totals,	11,234,764	8,911,971	2,322,793

	Receipts.	Sales.	Surplus.
1898,	11,317,761	8,564,682	2,753,079
1897,	11,798,191	8,738,572	3,059,619
1896,	10,772,108	8,087,378	2,684,730
1895,	9,856,500	8,040,732	1,815,768
1894,	9,705,447	7,657,421	2,048,026
1893,	9,263,487	7,619,722	1,643,765
1892,	9,212,667	7,315.135	1,897,532

The price agreed upon between producer and wholesaler is a theoretical figure, called the Boston price. There is a scale of discounts from this price, varying according to the distance from the city, so that, when the Boston price is agreed upon, each producer, knowing the belt or zone in which he lives, can get at the price that he will receive. This Boston price has been for several years as follows : —

	Summer (Cents per Can).	Winter (Cents per Can).		Summer (Cents per Can).	Winter (Cents per Can).
1886,	30	36	1893,	33	37
1887,	30	36	1894,	33	37
1888,	32	38	1895,	33	37
1889,	32	38	1896,	33	35
1890,	32	36	1897,	33	35
1891,	33	37	1898,	32	34
1892,	33	37	1899,	32	34

The decline in 1898 and 1899 is only a paper one. The scale of discounts from the Boston price was decreased for those years, so that the net to the farmers was unchanged.

Condensed Milk.

During the past year the agents of the Bureau happened upon some samples of condensed milk which were not labelled with the name of the manufacturer according to law. This being suspicious, samples were taken for analysis, and the chemist reported that they were materially deficient in fat; consequently, cases were entered in court. As soon as the news reached the manufacturers, they made emphatic protestations as to the quality of the milk and the probable error in sampling or analysis. Their statements were so emphatic, and apparently so sincere, that it seemed both prudent and just to go extremely slow, and verify the chemical work of Dr. Davenport. As a result of this caution, he ascertained a fact unknown to general commercial chemists and authors of text books on the subject, though in the possession of a few specialists employed by condensed milk manufacturers, — that the addition of cane sugar to condensed milk, which is done by the majority of manufacturers, locks up the fat globules in such a peculiar way that ordinary processes of analysis fail to secure all of it; on discovering this, and using different processes, the original work was found to be in error, and the cases withdrawn.

Cream.

The consumption of cream is increasing very rapidly in Massachusetts. In all of the large cities cream has become a staple article in all grocery and provision stores, while large amounts are delivered by the milk peddler. Most of this cream comes from Maine, and several Maine creameries have built up an enormous business. Professor Cooley estimates that only about one-twentieth of the cream sold in Massachusetts is produced in the State. It would seem as though the production of market cream holds out great possibilities to Massachusetts creameries, especially in view of the fact that the demand for cream is the largest in the summer, when the production of butter is largest, the surplus most burdensome. and the price the lowest. Where there is a market for cream, butter fat is worth from 2 to 3 cents a pound more in market cream than in butter. The

production of cream at creameries on the factory plan promotes uniformity in quality, and enhances popular confidence in it.

Cheese.

Cheese is the only dairy product in the State which requires very little or no work on the part of those entrusted with the enforcement of the dairy laws. There seems to be no effort to introduce adulterated or counterfeit cheese into the Massachusetts markets, largely, so far as we are informed, because most dealers are in the habit of buying cheese from sections where adulteration is not practised very much. The State law relative to adulterations is now reinforced by the national law against filled cheese, but we find none in the State.

The quality of cheese sold in the market varies greatly, and, as Massachusetts has no provisions relative to branding cheese, or relative to the fraudulent claim of cheese being full cream when it is made from partially skimmed milk, there is possibly an imposition on the public at times. Cheese made from whole milk will vary relatively as much in per cent of fat as does the milk itself; and full cream cheese from milk having 2.5 or 3 per cent of fat cannot be readily detected from cheese made from milk containing from 5 to 6 per cent of fat which has been partially skimmed.

Voluntary Assistance.

It frequently happens that the appropriation limits our work rather than inability to find something to do, and that important things must therefore be left undone. To promote efficiency and economy of action, the following circular was issued early in the year, and copies have been sent out from time to time to friends of the law: —

COMMONWEALTH OF MASSACHUSETTS.

Dairy Bureau.

Dear Sir: — Any information which you can give me relating to the illegal sale of dairy products or imitation dairy products (oleomargarine) in your town or city will be thankfully received and kept in strict confidence.

George M. Whitaker.

P. O. Box 1332, Boston, Mass.

This has resulted in securing much valuable assistance and putting us in possession of information which could not otherwise have been obtained, at least not without great expense.

Educational Work.

In this department more than the usual amount of work has been done, and the expense has been more than twice the average of the five preceding years. In last year's report we called attention to institutes held in co-operation with the Massachusetts Creamery Association. Early in this year a buttermakers' institute was held by the Dairy Bureau and the Creamery Association at Amherst. It was a well-attended, profitable meeting, with a good program and a large exhibit of butter,— 41 entries in all. The papers read at this institute and the results of the meeting were so important that the Bureau issued a special bulletin, giving a report of the same; it is therefore unnecessary to repeat the substance here.

The Worcester South Agricultural Society has continued its offer of a prize for the cow giving the greatest amount of butter fat on the society's grounds during twenty-four hours of the society's exhibition. This prize has been awarded by the representative of the Bureau for several years, and the custom was continued this year. The following is the statistical result of the test: —

Melvin Shepard, *Sturbridge, Mass.* (*Grade Jersey*).

	Weight of Milk.	Per Cent of Fat.	Weight of Fat.
	lbs.		lbs.
Night,	12.06	5.00	.603
Morning,	14.00	5.00	.700
Totals,	26.06	-	1.303

C. L. Underwood, *East Brookfield, Mass.* (*Grade Guernsey*).

	lbs.		lbs.
Night,	17.75	3.80	.674
Morning,	17.01	3.20	.544
Totals,	34.76	-	1.218

J. E. MAHAN, *Charlton, Mass.*

	Weight of Milk.	Per Cent of Fat.	Weight of Fat.
	lbs.		lbs.
Night, ...	8.56	6.60	.565
Morning, ...	5.06	6.00	.303
Totals, ...	13.62	–	.868

A. L. WOODIS, *North Brookfield, Mass.*

	lbs.		lbs.
Night, ...	8.12	3.60	.292
Morning, ...	11.06	3.60	.398
Totals, ...	19.18	–	.690

This system of judging milch cows is excellent, and the Worcester South Agricultural Society is entitled to credit for its pioneer educational work in this line, the more so because anything of this kind does not appeal to the crowd, and has nothing spectacular about it to draw admission fees and increase the society's income. It is purely educational, but of great value in that way. The ideal work in this line, however, is in testing cows at the barns where they are ordinarily kept, as sometimes the driving to the fair grounds and the unusual noises and conditions at the show have such an effect upon the nervous temperament of the animal that she does not do her best.

The inspection of creameries, to which allusion has been previously made and from which some statistics have been quoted, was of value to the creameries from the educational stand-point, and elicited some technical information, which will be the subject of a special bulletin.

The representative of the Bureau has been called upon 16 times to address farmers' meetings or to speak on dairy topics. Three meetings of this kind have been held where members of the Bureau or of the Cattle Commission have been speakers, making in all 19 meetings to the credit of

the Bureau. At several meetings addressed by Mr. Whitaker the Babcock tester has been used, and 87 samples of milk tested. In addition to the above, he has attended a meeting of the Pure Food Congress in Washington, and meetings of the State Association of Boards of Health.

The following is the manner in which the appropriation of $7,000 has been expended: —

Members of the Bureau, travelling expenses and attending meetings,	$371 29
Agents' salaries,	1,657 77
Agents' expenses,	2,299 15
Chemist,	1,320 15
George M. Whitaker, travelling and office expenses, supplies, mileage tickets, etc.,	850 48
Educational work,	421 04
Printing and supplies,	80 12
Total,	$7,000 00

GEORGE M. WHITAKER.

Accepted and adopted as the report of the Dairy Bureau.

D. A. HORTON.
J. L. ELLSWORTH.
C. D. RICHARDSON.

ANNUAL REPORT

OF THE

BOARD OF CATTLE COMMISSIONERS

OF THE

COMMONWEALTH OF MASSACHUSETTS.

JANUARY 9, 1900.

REPORT OF THE BOARD OF CATTLE COMMISSIONERS.

To the Honorable Senate and House of Representatives.

The Board of Cattle Commissioners herewith presents its annual report, as required by section 3, chapter 408, Acts of 1899, of the work it has performed during the past year.

The Legislature of 1899 recodified the laws relating to the contagious diseases of animals, this recodification being chapter 408, Acts of 1899, which went into effect May 25 last.

During the past year the commission has acted under two sets of laws: until May 25 it carried out the provisions of chapter 491, Acts of 1894, as amended by chapters 476 and 496, Acts of 1895, and further amended by chapters 454 and 486, Acts of 1896; since then it has had the enforcement of the new law to deal with.

It seemed best to the last Legislature to codify and consolidate the laws under which the Cattle Commission worked; for, although the last codification of these laws was as recent as 1894, yet there had been numerous amendments to them every year since, making them bulky, beside which they required a good deal of work from the commission which had more to do with local health matters than with the suppression of contagious diseases among domestic animals throughout the State. It was also the opinion of the last Legislature that a Board of three commissioners would be a more convenient size than one of five, as it had been since 1894, and that a smaller Board could administer the law more expeditiously and economically. The new law also brings the inspectors of animals in the various cities and towns into more direct business relations with the Board than formerly, thus stripping it of much of the red tape that had hampered it, and bringing the inspectors of animals more under the immediate control of the commission, rendering it easier to make

them act in unison with the Board and doing away with much of the delay that sometimes occurred in the management of cases of contagious diseases among the live stock of the State. The modifications made in the law it was hoped would also result in making it possible to carry forward the work of extirpating the communicable animal diseases at a much less expense to the State than heretofore, at the same time providing for ample protection to the public health.

The clause in the law under which the change was made is section 1 of chapter 408, Acts of 1899: —

The governor, with the advice and consent of the council, shall appoint a board of cattle commissioners of not more than three members, whose terms of office shall begin on the first day of June, in the year eighteen hundred and ninety-nine, and who shall hold office as follows: one of said members for the term of three years, one for the term of two years, and one for the term of one year, and thereafter one of said members shall be appointed annually for the term of three years.

His Excellency Roger Wolcott under this provision of the law appointed Austin Peters of Boston for three years, Leander F. Herrick of Worcester for two years and Charles A. Dennen of Pepperell for one year. The appointees qualified June 8, and a meeting was immediately held, whereupon the Board organized by electing Austin Peters chairman and Leander F. Herrick secretary.

The aim of the law is, as it has been in the past, to check and diminish the ravages of diseases among domestic animals that cause annually large pecuniary losses to their owners, and at the same time to protect the people from those that are in any way a danger to the health and lives of human beings. The diseases of animals that are enumerated under the law as contagious are given in section 35, as follows: —

Contagious diseases under the provisions of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinder-pest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis.

If any disease, however, not given in the act should appear among the animals of the State, and seem to be of a communicable character, the Board would feel it its duty to act in such an emergency if the public good required it.

For the purpose of carrying out the provisions of this act the Legislature appropriated the sum of $75,000; but it has been found possible to administer the law at an expense of about half this amount. This being the case, the commission has asked that a less sum, $50,000, be placed at its disposal another year as sufficient to meet any expenses that may be caused by the provisions of the act.

It is to be hoped that the law is now placed upon a satisfactory basis, and that, if the work of controlling contagious animal diseases is to be permanent (as it should be, and has been in Massachusetts for forty years), the Cattle Commission will have a sufficient annual appropriation to meet the expenses required by the law made early in the legislative session, instead of having to wait four or five months every year before any funds are available to even pay the clerks who are necessary for attending to the business of the office. While the expenses of the law are largely due to the cost of that portion of the work entailed upon it by the effort to suppress bovine tuberculosis, this Board must not be looked upon as nothing more than a tuberculosis commission; for, while the expense is largely caused by tuberculosis, the State paying full appraised value for tuberculous cattle up to a limit not exceeding $40, and tuberculosis among cattle being the most prevalent of the contagious animal diseases which we at present have to deal with, yet, because the cost of dealing with glanders and rabies is less, these diseases should not be looked upon as less important or less dangerous.

Every city and town was formerly required to appoint one or more inspectors of "animals and provisions," who, besides examining animals for contagious diseases, had to inspect markets, and animals at the time of slaughter either at slaughter houses or on the owners' premises, the Board of Cattle Commissioners receiving the returns of slaughtered animals from the inspectors on blanks furnished from its office. It also had to furnish blanks for applications for and

licenses of slaughter houses all over the State, and received a duplicate of each license given in every city and town. This made a great deal of extra work for the commission, and was really a local health matter, and had little to do with suppressing contagious diseases among animals. Section 20 of the new law provides that this work shall in the future be in the hands of the local boards of health.

Under the act of 1899 the Board of Cattle Commissioners knows only an inspector of animals appointed as provided for in section 17 : —

The mayor and aldermen of cities, except as provided in chapter two hundred and fifty of the acts of the year eighteen hundred and ninety-six, and the selectmen of towns shall, within thirty days after the passage of this act, and thereafter annually in the month of March, appoint one or more persons to be inspectors of animals, subject to the approval of the board of cattle commissioners. Each inspector shall be sworn faithfully to discharge the duties of his office, and shall receive a reasonable compensation, to be paid by the city or town for which he is appointed. Such city and town officers shall have the power to remove any inspector appointed by them, and in such case shall immediately appoint another in his place. Every city and town shall, within thirty days after the passage of this act, and thereafter before the first day of April in each year, send to the board of cattle commissioners a list of the qualified inspectors of animals appointed under this section for such city or town, which notice shall give the name and address of each such inspector and his occupation.

June 12 the Board sent the following letter to the mayors of cities and selectmen of towns : —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Boston, June 12, 1899.

Dear Sirs : — Herewith find a copy of chapter 408 of the Acts of 1899. This act recodifies the laws relating to the contagious diseases of animals.

You will see by section 17 that there shall be appointed, within thirty days after the passage of this act, and thereafter annually in the month of March, an *inspector* or *inspectors* of animals. Will you, therefore, immediately appoint an *inspector* of *animals*, or more than one, if you think it necessary. In most cities and towns it seems to us one inspector of animals is sufficient.

You will further note that such appointments are subject to the approval of the Board of Cattle Commissioners. This Board prefers that a competent veterinary surgeon be appointed to this position, when one resides in the locality and his services can be procured. Any unfit appointees will be rejected by this Board. You will please notify the Board of Cattle Commissioners at once upon making the appointment.

Section 20 provides that the licensing of slaughter houses and the inspection of animals killed for food, as provided for in chapter 491, Acts of 1894, and acts in amendment thereto, shall hereafter be attended to by local boards of health.

AUSTIN PETERS, *Chairman*,
LEANDER F. HERRICK, *Secretary*,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

This resulted in the appointment of the following inspectors: —

TOWN.	Name.	Occupation.
Abington, ...	John N. Chamberlain, .	Retired.
Acton, ...	Moses A. Reed, . . .	Farmer.
Acushnet, ...	Philip A. Bradford, . .	Farmer.
Adams, ...	Andrew G. Potter, . .	Veterinarian.
Agawam, ...	Edwin Leonard, . .	Farmer.
Alford, ...	Samuel K. Williams, .	Farmer.
Amesbury, ...	Edward S. Worthen, .	–
Amherst, ...	Henry E. Paige, . .	Veterinarian.
Andover, ...	Charles H. Newton, . .	Farmer.
Arlington, ...	Lawrence L. Pierce, . .	Veterinarian.
Arlington, ...	Alonzo S. Harriman, .	Chief of police.
Ashburnham, . . .	Charles W. Whitney, .	Farmer.
Ashby, ...	Charles B. Shaw, . .	Veterinarian.
Ashfield, ...	Walter G. Lesure, . .	Farmer.
Ashland, ...	Samuel D. Witt, . .	Farmer.
Athol, ...	Oscar F. Stearns, . .	Veterinarian.
Attleborough, . . .	George Mackie, . .	Physician.
Attleborough, . . .	Charles S. Holden, . .	Physician.
Auburn, ...	Emory Stone, . . .	Farmer.
Avon, ...	Charles E. May, . .	Physician.

TOWN.	Name.	Occupation.
Ayer,	James J. O'Brien,	Insurance agent.
Barnstable,	J. J. Maloney,	Veterinarian.
Barre,	Henry L. Conant,	Auctioneer.
Becket,	Wm. H. Snow,	-
Bedford,	Henry Wood,	Cattle dealer
Belchertown,	Guy C. Allen,	Farmer.
Bellingham,	Carroll E. White,	Farmer.
Belmont,	Benj. A. Harris,	Veterinarian.
Berkley,	Eliphalet Terry,	Farmer.
Berlin,	Robert B. Wheeler,	Farmer.
Bernardston,	Charles Bowker,	Physician.
Beverly,	Horace D. Lambert,	Veterinarian.
Billerica,	Wm. H. Hutchins,	Farmer.
Blackstone,	Daniel H. Cooney,	Farmer.
Blackstone,	Elias M. Billings,	Farmer.
Blandford,	H. K. Herrick,	Farmer.
Blandford,	George Cadwell,	Farmer.
Blandford,	Frank J. Candee,	Farmer.
Bolton,	Henry F. Haynes,	Farmer.
Boston,	Alexander Burr,	Veterinarian.
Bourne,	Noble P. Swift,	Farmer.
Boxborough,	Philip W. Cunningham,	Farmer.
Boxford,	Charles A. Andrews,	Farmer.
Boylston,	Luther S. Hapgood,	Farmer.
Braintree,	Edward W. Hobart,	Farmer.
Brewster,	Henry E. Baker,	Trader.
Bridgewater,	Calvin Pratt,	Physician.
Brimfield,	Porter A. Parker,	Farmer.
Brockton,	Waldo H. Brownell,	Veterinarian.
Brockton,	Isaac H. Harris,	Laborer.
Brookfield,	George Allen,	Farmer.
Brookline,	Frederick H. Osgood,	Veterinarian.
Buckland,	Jacob G. Pfersick,	Veterinarian.
Burlington,	James N. Stuart,	Veterinarian.
Cambridge,	Charles E. Hadcock,	Veterinarian.
Canton,	Patrick J. Cronon,	Veterinarian.
Carlisle,	George P. Davis,	Farmer.

TOWN.	Name.	Occupation.
Carver, . . .	Benj. W. Robbins, . .	Farmer.
Charlemont, . . .	Wm. B. Avery, . . .	Farmer.
Charlton, . . .	Stephen Hammond, . .	Butcher.
Chatham, . . .	Walden F. Harding, . .	Butcher.
Chelmsford, . . .	Walter R. Winning, . .	Farmer.
Chelsea, . . .	William Stinson, . .	Veterinarian.
Cheshire, . . .	Wm. P. Bennett, . .	Retired.
Chester, . . .	Daniel B. Holcomb, . .	Retired.
Chesterfield, . . .	Thomas K. Utley, . .	Farmer.
Chicopee, . . .	Irving H. Elmer, . .	Butcher.
Chicopee, . . .	Thomas Goodwin, . .	Veterinarian.
Chilmark, . . .	Freeman Hancock, . .	Farmer.
Clarksburg, . . .	Dexter S. Bishop, . .	Farmer.
Clinton, . . .	Eugene H. Lehnert, . .	Veterinarian.
Cohasset, . . .	Darius W. Gilbert, . .	Veterinarian.
Colrain, . . .	C. Webster Smith, . .	Farmer.
Colrain, . . .	John D. Gilchrist, . .	Farmer.
Concord, . . .	Elijah D. Harris, . .	Veterinarian.
Conway, . . .	Gordon H. Johnson, . .	Farmer.
Cottage City, . .	Edmund G. Beetle, . .	Retired.
Cummington, . .	Edward F. Warner, . .	Farmer.
Cummington, . .	Myron D. Trow, . .	Farmer.
Dalton, ...	Wm. Miller, . . .	Farmer.
Dana, ...	C. N. Doane, . . .	Farmer.
Dana, ...	Alfred W. Doane, . .	Farmer.
Danvers, . . .	Charles S. Moore, . .	Veterinarian
Dartmouth, . . .	Charles W. Howland, .	Farmer.
Dartmouth, . . .	Charles H. Negus, . .	Butcher.
Dartmouth, . . .	James E. Allen, . .	Farmer.
Dedham, . . .	Edward Knobel, . .	Veterinarian.
Deerfield, . . .	Dwight A. Hawks, . .	Farmer.
Dennis, . . .	John P. Howes, . .	Farmer.
Dennis, . . .	Charles E. Baker, . .	Painter.
Dighton, . . .	Wm. H. Walker, . .	Farmer.
Douglas, . . .	Walter E. Cook, . .	Farmer.
Dover, ...	Edward A. James, . .	Farmer.
Dracut, . . .	Clement A. Hamblet, .	Veterinarian.

TOWN.	Name.	Occupation.
Dudley,	Monroe W. Ide,	Farmer.
Dunstable,	Franklin N. Tolles,	Veterinarian.
Duxbury,	John K. Parker,	Farmer.
East Bridgewater,	Isaac T. Hatch,	Veterinarian.
East Longmeadow,	Edwin Indicott,	Farmer.
Eastham,	Reuben H. Horton,	Farmer.
Easthampton,	Fordyce Whitmarsh,	Retired.
Easton,	Edward R. Hayward,	Farmer.
Edgartown,	Christopher R. Beetle,	Farmer.
Egremont,	Wm. F. Crippen,	Farmer.
Enfield,	Joseph P. Walker,	Farmer.
Erving,	W. P. G. Huntoon,	Farmer.
Essex,	David L. Haskell,	Farmer.
Everett,	William Stinson,	Veterinarian.
Fairhaven,	Ebenezer G. Grinnell,	Farmer.
Fall River,	Joseph E. E. Lanoie,	Physician.
Falmouth,	Barzillai C. Cahoon,	Horse dealer.
Falmouth,	Herbert H. Lawrence,	Farmer.
Falmouth,	Lewis F. Weeks,	Veterinarian.
Fitchburg,	Charles A. Keene,	Veterinarian.
Florida,	Nathan W. Kemp,	Farmer.
Foxborough,	Abijah W. Draper,	Veterinarian.
Foxborough,	Norton R. Dennis,	Butcher.
Framingham,	Walter P. Mayo,	Veterinarian.
Franklin,	Wm. F. King,	Farmer.
Freetown,	Charles H. Read,	Gunsmith.
Freetown,	Charles E. Chace,	Farmer.
Gardner,	Augustus S. Cleaves,	Veterinarian.
Gay Head,	Samuel J. Haskins,	Farmer.
Georgetown,	Samuel T. Poor,	Farmer.
Georgetown,	J. Winfred Yeaton,	Farmer.
Gill,	John L. S. Moore,	Farmer.
Gloucester,	Fred Corliss,	Stone mason.
Goshen,	Willis A. Smith,	Farmer.
Gosnold,	George F. Bosworth,	Farmer.
Grafton,	Perley Goddard,	Farmer.
Granby,	F. A. Forward,	Farmer.

TOWN.	Name.	Occupation.
Granville, . . .	George W. Cone, . .	Farmer.
Granville, . . .	Charles D. Treat, . .	Farmer.
Great Barrington, .	Edwin S. Hurlburt, . .	Veterinarian.
Great Barrington, .	George H. Cobb, Jr., .	Liveryman.
Greenfield, . . .	Mark L. Miner, . . .	Veterinarian.
Greenwich, . . .	Edward M. Hunter, . .	Farmer.
Groton, . . .	Solon R. Dodge, . .	Butcher.
Groveland, . . .	Thomas E. Snell, . .	Farmer.
Hadley, . . .	Charles H. Hunt, . .	Farmer.
Hadley, . . .	Homer L. Cowles, . .	Farmer.
Halifax, . . .	Jabez P. Thompson, . .	Farmer.
Hamilton, . . .	George R. Dodge, . .	Farmer.
Hampden, . . .	Moses H. Warren, . .	Farmer.
Hancock, . . .	James S. Goold, . .	Farmer.
Hanover, . . .	Andrew T. Damon, . .	Grocer.
Hanson, . . .	Elbridge M. Perkins, .	Farmer.
Hardwick, . . .	John N. Hillman, . .	Farmer.
Harvard, . . .	Eli W. Hosmer, . .	Farmer.
Harwich, . . .	John A. Baker, . . .	Produce dealer.
Hatfield, . . .	E. S. Warner, . . .	Farmer.
Haverhill, . . .	Grantley Bickell, . .	Veterinarian.
Hawley, . . .	Lewis W. Temple, . .	Farmer.
Heath, ...	V. D. Thompson, . .	Farmer.
Hingham, . . .	R. Foster Robinson, . .	Farmer.
Hinsdale, . . .	Frank C. Phillips, . .	Farmer.
Holbrook, . . .	Charles W. Staples, . .	Farmer.
Holden, . . .	E. W. Merrick, . . .	Deputy sheriff.
Holland, . . .	A. J. Bagley, . . .	Carpenter.
Holliston, . . .	Isaac A. Smith, . . .	Veterinarian.
Holyoke, . . .	John J. Moynahan, . .	Veterinarian.
Hopedale, . . .	Lewis B. Gaskill, . .	Farmer.
Hopkinton, . . .	Winslow W. Claflin, . .	Farmer.
Hubbardston, . .	John H. Burtch, . .	Farmer.
Hudson, . . .	A. L. Cundall, . . .	Veterinarian.
Hull, ...	Fred C. Harris, . . .	Milkman.
Huntington, . . .	Allen M. Coit, . . .	Farmer.
Huntington, . . .	Frank E. Cone, . . .	Farmer.

TOWN.	Name.	Occupation.
Hyde Park, . . .	Joseph M. Kiggen, . .	Veterinarian.
Ipswich, . . .	E. Newton Brown, . .	Farmer.
Kingston, . . .	E. Elbridge Atwood, .	Farmer.
Lakeville, . . .	Isaac Sampson, . . .	Farmer.
Lancaster, . . .	Albert E. Harriman, . .	Veterinarian.
Lancaster, . . .	Albert E. Carr, . . .	Farmer.
Lanesborough, . .	Wm. P. Talcott, . .	Painter.
Lawrence, . . .	John F. Winchester, . .	Veterinarian.
Lee, ...	John H. McAllister, . .	Veterinarian.
Leicester, . . .	Henry B. Watts, . .	Florist.
Leicester, . . .	Daniel A. Craig, . .	Farmer.
Lenox, ...	Charles C. Flint, . .	Physician.
Leominster, . . .	Wm. H. Dodge, . . .	Veterinarian.
Leverett, . . .	Orman C. Marvell, . .	Farmer.
Lexington, . . .	Charles M. Parker, . .	Farmer.
Leyden, . . .	Wm. A. Barber, . .	Farmer.
Lincoln, . . .	Martin M. Welch, . .	Farmer.
Littleton, . . .	Joseph N. Murray, . .	Veterinarian.
Longmeadow, . .	Spencer W. Gates, . .	Farmer.
Lowell, . . .	Walter A. Sherman, . .	Veterinarian.
Ludlow, . . .	Adelbert L. Bennett, . .	Farmer.
Lunenburg, . . .	Charles E. Woods, . .	Physician.
Lynn, ...	Alexander S. Wright, .	Accountant.
Lynnfield, . . .	Wm. R. Roundy, . .	Farmer.
Malden, . . .	Wm. Simpson, . . .	Veterinarian.
Manchester, . . .	Charles S. Moore, . .	Veterinarian.
Mansfield, . . .	Joseph N. Tebbetts, . .	Farmer.
Marblehead, . .	Benj. F. Goodwin, . .	Building mover.
Marion, . . .	George F. Richards, . .	Contractor.
Marlborough, . .	Patrick J. Mahoney, . .	Veterinarian.
Marshfield, . . .	Franklin W. Hatch, . .	Stable keeper.
Mashpee, . . .	Nathaniel D. Bearse, .	Laborer.
Mattapoisett, . .	Fred L. Dexter, . .	Stable keeper.
Maynard, . . .	Willis A. White, . .	Cattle dealer.
Medfield, . . .	Herbert W. Hutson, . .	Farmer.
Medford, . . .	Henry F. Moore, . .	Milk inspector.
Medway, . . .	Edward Whiting, . .	Farmer.

TOWN.	Name.	Occupation.
Melrose,	Frank P. Sturges,	Veterinarian.
Mendon,	Albert W. Gaskill,	Farmer.
Merrimac,	Charles A. Wallace,	Farmer.
Methuen,	Edwin J. Castle,	Veterinarian.
Middleborough,	Chester P. Keith,	Veterinarian.
Middlefield,	J. T. Bryan,	Farmer.
Middleton,	Andrew W. Peabody,	Farmer.
Milford,	Edward E. Cook,	Livery stable.
Millbury,	Henry W. Carter,	Farmer.
Millis,	Moses C. Adams,	Farmer.
Milton,	James Spencer,	Veterinarian.
Monroe,	David H. Sherman,	Farmer.
Monson,	Wm. H. Bugbee,	Farmer.
Montague,	George H. Goddard,	Farmer.
Montague,	S. H. Amidon,	Builder.
Monterey,	Delmer C. Tryon,	Farmer.
Montgomery,	W. B. Cushman,	Farmer.
Mount Washington,	Alfred I. Spurr,	Veterinarian.
Nahant,	Robert L. Cochran,	Health officer.
Nantucket,	Herbert G. Worth,	Stable keeper.
Natick,	John W. Robinson,	Veterinarian.
Needham,	Samuel O. Fowle,	Veterinarian.
New Ashford,	Van Ness Mallery,	Farmer.
New Bedford,	Daniel C. Ashley,	Veterinarian.
New Braintree,	Charles A. Felton,	Farmer.
New Marlborough,	Ralph I. Rhoades,	Farmer.
New Salem,	Frederick Abbott,	Farmer.
Newbury,	Asa Pingree,	Farmer.
Newburyport,	George W. Knight,	Health officer.
Newton,	James R. McLaughlin,	Veterinarian.
Norfolk,	Andrew R. Jones,	Farmer.
North Adams,	Angus A. McDonell,	Veterinarian.
North Andover,	George S. Fuller,	Veterinarian.
North Attleborough,	W. Henry Kling,	Printer.
North Brookfield,	Alfred O. Boyd,	Veterinarian.
North Brookfield,	Benj. F. Barnes,	Veterinarian.
North Reading,	F. H. Mosman,	Expressman.

TOWN.	Name.	Occupation.
Northampton,	John H. Roberts,	Veterinarian.
Northborough,	Allyn D. Phelps,	Farmer.
Northbridge,	George F. Nilsson,	Farmer.
Northbridge,	W. A. Beane,	Farmer.
Northfield,	A. L. Newton,	Physician.
Norton,	Erastus B. Codding,	Farmer.
Norwell,	J. Warren Foster,	Peddler.
Norwood,	Albert Fales,	Farmer.
Oakham,	Sanford H. Bullard,	Farmer.
Orange,	Amos Blodgett,	Farmer.
Orleans,	Edmund Linnell,	Farmer.
Otis,	Edwin L. Downs,	Farmer.
Oxford,	Fred L. Snow,	Farmer.
Palmer,	Charles F. Smith,	Farmer.
Palmer,	E. W. Phinney,	Farmer.
Paxton,	Cleveland N. Glidden,	Farmer.
Peabody,	Charles Davis,	Veterinarian.
Peabody,	Cyrus T. Batchelder,	Assessor.
Peabody,	John E. Herrick,	Farmer.
Pelham,	John A. Page,	Farmer.
Pembroke,	Clifford I. Rogers,	Farmer.
Pepperell,	Samuel P. Bancroft,	Farmer.
Peru,	F. G. Creamer,	Merchant.
Petersham,	S. C. Goddard,	Farmer.
Phillipston,	Robt. E. McLane,	Farmer.
Pittsfield,	George N. Kinnell,	Veterinarian.
Plainfield,	E. A. Atkins,	Farmer.
Plainfield,	D. H. Gould,	Farmer.
Plymouth,	Clark Finney, Jr.,	Milkman.
Plympton,	Howard O. Bonney,	Farmer.
Prescott,	Henry N. Grover,	Cream gatherer.
Princeton,	George Mason, Jr.,	Farmer.
Provincetown,	Artemus P. Hannum,	Town official.
Quincy,	Francis Abele, Jr.,	Veterinarian.
Randolph,	Lincoln Stetson,	Cattle dealer.
Raynham,	Cyrus Leonard, 2d,	Cattle dealer.
Reading,	Calvert H. Playdon,	Veterinarian.

TOWN.	Name.	Occupation.
Rehoboth, . . .	Joseph F. Earle, . .	Town auditor.
Revere, . . .	William Stinson, . .	Veterinarian.
Richmond, . . .	C. H. Dorr, . . .	Farmer.
Rochester, . . .	Allen G. Ashley, . .	Farmer.
Rockland, . . .	Charles Winslow, . .	Veterinarian.
Rockport, . . .	Robert Tarr, . . .	Farmer.
Rowe, ...	E. M. Upton, . . .	Farmer.
Rowley, . . .	Daniel H. Hale,. . .	Farmer.
Rowley, . . .	J. Scott Todd, . . .	Farmer.
Royalston, . . .	George E. Pierce, . .	Farmer.
Royalston, . . .	John Davis, . . .	Farmer.
Royalston, . . .	Joseph Stewart, . .	Farmer.
Russell, . . .	Sidney S. Shurtleff, . .	Farmer.
Rutland, . . .	George S. Putnam, . .	–
Salem, ...	Fred J. Saunders, . .	Veterinarian.
Salisbury, . . .	John Q. Evans, . . .	Farmer.
Sandisfield, . . .	Henry S. Manley, . .	Farmer.
Sandwich, . . .	Joshua E. Holway, . .	Farmer.
Saugus, . . .	Arthur W. Sawyer, . .	Veterinarian.
Savoy, ...	H. C. Phelps, . . .	Farmer.
Savoy, ...	M. A. Bliss, . . .	Farmer.
Scituate, . . .	Caleb L. Damon, . .	Farmer.
Seekonk, . . .	Robt. Woodward, . .	Farmer.
Sharon, . . .	C. Elbert Howard, . .	Farmer.
Sheffield, . . .	Henry C. Clark, . .	Town clerk.
Sheffield, . . .	Edwin L. Boardman, .	Farmer.
Shelburne, . . .	Jacob G. Pfersick, . .	Veterinarian.
Sherborn, . . .	Jasper J. Smart, . .	Veterinarian.
Shirley, . . .	Samuel B. Scott, . .	Farmer.
Shrewsbury, . .	John F. Knight, . .	Farmer.
Shutesbury, . . .	Fred H. Plympton, . .	Farmer.
Somerset, . . .	Thomas A. Francis, . .	Marketman.
Somerville, . . .	Charles M. Berry, . .	Provision dealer.
South Hadley, . .	Horace W. Gaylord, . .	Farmer.
Southampton, . .	Henry E. Coleman, . .	Farmer.
Southborough, . .	Israel G. Howe, . .	Farmer.
Southbridge, . .	J. A. Genereaux, . .	Physician.

TOWN.	Name.	Occupation.
Southwick,	Charles W. Talmadge,	Farmer.
Spencer,	W. J. Meloche,	Veterinarian.
Springfield,	James Kimball,	Health officer.
Sterling,	William S. Walker,	Farmer.
Stockbridge,	Marshall S. Heath,	Farmer.
Stockbridge,	John M. Buck,	Farmer.
Stoneham,	George H. Allen,	Veterinarian.
Stoughton,	James Murphy,.	Veterinarian.
Stow,	Pearl W. Packard,	Farmer.
Sturbridge,	William Whittemore,	Farmer.
Sudbury,	George A. Haynes,	Farmer.
Sunderland,	George P. Smith,	Farmer.
Sutton,	H. Scott Stockwell,	Farmer.
Swampscott,	George Newhall,	Gardener.
Swanzey,	Charles Gifford,	Farmer.
Taunton,	Walter H. Haskell,	Veterinarian.
Templeton,	S. E. Greenwood,	Physician.
Templeton,	W. F. Robie,	Physician.
Tewksbury,	George W. Trull,	Farmer.
Tisbury,	Henry C. Norton,	Farmer.
Tolland,	John R. Rogers,	Farmer.
Tolland,	Luke R. Moore,	Farmer.
Topsfield,	Eugene L. Wildes,	Farmer.
Townsend,	John N. Going,	Farmer.
Truro,	John G. Thompson,	Trader.
Tyngsborough,	R. B. Sherburne,	Farmer.
Tyringham,	Isaac B. Tinker,	Farmer.
Upton,	George D. Whitney,	Farmer.
Uxbridge,	Charles E. Seagrave,	Farmer.
Wakefield,	Henry C. Perry,	Veterinarian.
Wales,	Warren W. Eager,	Wool dealer.
Walpole,	Almond F. Boyden,	Farmer.
Waltham,	Wm. E. Peterson,	Veterinarian.
Ware,	A. A. Etienne,	Veterinarian.
Wareham,	Prince H. Swift,	Farmer.
Warren,	William E. Patrick,	Farmer.
Warwick,	Gilbert Maynard,	Farmer.

TOWN.	Name.	Occupation.
Washington,	William A. Eames,	Farmer.
Watertown,	George W. Pope,	Veterinarian.
Wayland,	Thomas Bryant,	Veterinarian.
Webster,	Leon H. Paquin,	Veterinarian.
Wellesley,	Samuel O. Fowle,	Veterinarian.
Wellfleet,	George W. Nickerson,	Horse dealer.
Wendell,	George A. Lewis,	Farmer.
Wenham,	Henry Alley,	Apiarist.
West Boylston,	H. J. Harlow,	–
West Bridgewater,	David R. Simmons,	Retired.
West Brookfield,	Charles E. Smith,	Farmer.
West Newbury,	Alfred L. Moore,	Farmer.
West Springfield,	Thomas J. Shinkwin,	Veterinarian.
West Stockbridge,	Ralph R. Bissell,	Farmer.
West Tisbury,	William B. Luce,	Fisherman.
Westborough,	Albert B. Ward,	Farmer.
Westfield,	Michael F. Hoar,	Veterinarian.
Westford,	George T. Day,	Farmer.
Westford,	Albert P. Richardson	Farmer.
Westhampton,	A. D. Montague,	Farmer.
Westminster,	M. D. Whitney,	Farmer.
Weston,	Everett O. Clark,	Cattle dealer.
Weston,	Gilbert A. Blood,	Cattle dealer.
Westport,	George A. Tripp,	Farmer.
Westport,	Eli Handy,	Farmer.
Weymouth,	Hiram E. Raymond,	Janitor.
Whately,	Irving Allis,	Farmer.
Whitman,	Owen F. Bumpus,	Veterinarian.
Wilbraham,	Jesse L. Rice,	–
Williamsburg,	Hallock H. Nichols,	Farmer.
Williamstown,	Lemuel C. Torrey,	Farmer.
Wilmington,	H. Allen Sheldon,	Farmer.
Winchendon,	William A. DeLand,	Auctioneer.
Winchester,	John W. Hemingway,	Milkman.
Windsor,	H. W. Ford,	Farmer.
Windsor,	G. L. Miner,	Farmer.
Winthrop,	John McNaught,	Veterinarian.

TOWN.	Name.	Occupation.
Woburn, . . .	James N. Stuart, . .	Veterinarian.
Worcester, . . .	Thomas Monahan, . .	Butcher.
Worthington, . .	Charles F. Bates, . .	Farmer.
Wrentham, . . .	Elisha M. Brastow, . .	Veterinarian.
Westwood, . . .	Creighton Colburn, . .	Veterinarian.
Yarmouth, . . .	James Lack, . . .	Farmer.
Yarmouth, . . .	Isaiah Homer, . . .	Farmer.
Yarmouth, . . .	Isaiah Crowell, . . .	Farmer.

It will be seen from the above list that many of the inspectors are veterinarians, especially in the cities and larger towns. This is very desirable where the services of such men can be obtained, as they have a technical training in the diseases of animals that especially fits them for the positions, provided they are citizens of good standing in the community and take an interest in the duties devolving upon them; at the same time, an honest, painstaking inspector who is not a veterinarian is to be preferred to a veterinarian who is careless and slovenly in doing his work, and who lacks interest and integrity of purpose. In many of the smaller communities it is not possible to secure the services of a veterinary surgeon as inspector; in such instances any conscientious cattle man makes a good inspector. Physicians, when interested in sanitary work, also make good inspectors. In a few places there is a tendency to allow politics to play a part in the appointment of inspectors, but in the great majority of the towns and cities of the Commonwealth there seems to be an intention to endeavor to secure the services of the best available men for these positions.

The section of the present law requiring cities and towns to appoint inspectors of animals provides that they shall be appointed subject to the approval of the Board of Cattle Commissioners. This gives the Board the power to refuse to confirm unfit appointments, and thus removes them to a certain extent from the influence of local politics, and ren-

ders it possible to elevate and improve the service. The Board under the law is also empowered to remove an inspector, if necessary, and order the appointment of another.

Tuberculosis is the disease for which the greater number of animals have been killed, and it is also the one which causes the most expense in carrying out the provisions of the law, therefore it will be referred to first in this report; but glanders and rabies must not be considered as being of very much less importance, when the dangers to human life and the losses the former causes to the horse owners of the State are taken into consideration.

Other diseases of an infectious character with which this Board has to deal are Texas fever, hog cholera or swine plague, actinomycosis and symptomatic anthrax.

The pathological and bacteriological work of the Board has been performed, as in the past two years, at the Harvard Medical School, by Dr. Langdon Frothingham, except that during a few months last summer while he was in Europe it was done at the laboratories at Bussey College, Forest Hills, by Dr. Arthur W. May, through the kind permission of Dr. Theobald Smith. For the laboratory facilities during the summer, and the kindly and valuable advice Dr. Smith has ever been ready to give the Massachusetts Cattle Commission, the renewed thanks of this Board are here given.

The Board was represented by its chairman at the annual meeting of the Interstate Association of Live Stock Sanitary Boards, held at Chicago, October 11 and 12, and was the only New England cattle commission represented. At this meeting the interests of the delegates from the south and south-west seemed to be centred in Texas fever; but those from points north of the Ohio and east of the Mississippi rivers appeared interested in diseases similar to those that we are likely to meet with in Massachusetts, as the conditions of agriculture in these states more nearly approach those of our own. The conference of the different cattle interests represented, together with the papers read and the discussions resulting from them, could not be otherwise than of mutual benefit to all present.

Financial Statement.

At the end of the year 1898, the appropriation made by the Legislature of that year being insufficient for the work of the commission, there remained unpaid bills to the amount of $4,900.42, as follows: —

For salaries of commissioners,	$3,060 00
For expenses of commissioners,	1,132 18
For salaries and expenses of agents in the suppression of glanders,	87 42
For expenses of laboratory and experimental work in the suppression of glanders and rabies,	145 75
For expenses of killing and burial of glandered horses,	28 00
For expenses of maintaining quarantine stations at Brighton, Watertown and Somerville,	447 07
Total,	$4,900 42

The payment of these accounts was provided for by the unexpended balance of the appropriation for 1898,	$385 63
And a deficiency appropriation made by chapter 95, Acts of 1899, approved Feb. 23, 1899, for the balance,	4,514 79
Total,	$4,900 42

The Legislature of 1899 made an appropriation of $75,000 for carrying on the work of the Cattle Commission, under the provisions of chapter 408, Acts of 1899.

The expenses of the work of "the extirpation, prevention and suppression of contagious diseases among domestic animals" for the year 1899, including all bills rendered and claims adjusted to December 15, are as follows: —

Paid for cattle condemned, killed and found tuberculous, 785 head, at an average of $22 each,		$17,277 69
Paid for cattle condemned, killed and no lesions found, 17 head, at an average of $23.24 each,		395 12
Paid for expenses of quarantine on 4 head,		9 00
Paid for expense of killing and burial,		9 00
		$17,690 81
Paid for salaries of commissioners,	$2,890 00	
Paid for expenses of commissioners,	1,151 29	
Paid for salaries of agents,	1,852 39	

Paid for expenses of agents,	$940 20	
Paid for salaries of clerks and stenographers,	2,108 50	
Paid for postage, stationery, printing and other office expenses,	990 36	
Paid expenses of laboratory and experimental work,	585 47	
Paid expenses of quarantine stations,	1,640 13	
Paid expenses of glanders, killing and burial,	51 05	
Paid for tuberculin and implements,	148 08	
		$12,357 47
Total payments,		$30,048 28

There has been received during the year from sales of hides and carcasses of condemned cattle, and paid to the State Treasurer, $771.57.

It is estimated that claims on cattle that have not been settled and bills coming due January 1 amount to in the neighborhood of $12,000, making the total expenses of the year somewhat over one-half of the sum appropriated.

Tuberculosis.

It will be seen from the above financial statement that the principal expenses incurred by the Board are in connection with the control of bovine tuberculosis. This work may be classified under the following heads: —

1. The supervision of the traffic in live cattle brought into the State.

2. A general inspection, the examination of cattle quarantined as diseased by the local inspectors in the various cities and towns, and the payment for those found to be infected with tuberculosis.

3. Testing entire herds for the purpose of permanently eradicating tuberculosis from the premises.

Under the first head are the cattle brought into the State through the quarantine yards at Watertown, Brighton and Somerville, and those brought in on permits to other points.

The first step necessary for continuing the control of the cattle business was to readopt the order of the previous Board; therefore, at a meeting of the Board of Cattle Commissioners, held June 26, the following order was adopted: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Commonwealth Building, 11 Mt. Vernon St.,
Boston, June 26, 1899.

To All Persons whom it may concern.

By virtue of the power and authority in us vested by law, and especially under the provisions of chapter 408 of the Acts of the year 1899, you are hereby notified that tuberculosis, which is a contagious disease, and is so recognized under the laws of this Commonwealth, exists among cattle of the several States and Territories of the United States, the District of Columbia and Canada, and such localities are, in the opinion of this Board, infected districts.

You are hereby further notified that, in order to prevent the importation of diseased animals, and as a means of suppressing such diseases within this Commonwealth, this Board has passed the following order: —

First. — No neat cattle brought from any State or Territory of the United States, the District of Columbia, Canada or any other country without the limits of this Commonwealth, shall be brought within the limits of this Commonwealth, except for delivery directly to the Union stock yards in the town of Watertown, the Boston & Albany stock yards in Brighton, within the city of Boston, or the premises of the New England Dressed Beef and Wool Company in the city of Somerville, except upon a permit signed by the Board of Cattle Commissioners or some one of its members; and no neat cattle so brought for delivery at any of said points shall be unloaded, except in case of accident, at any point other than the said Boston & Albany stock yards in Brighton, the Union stock yards in Watertown, or the New England Dressed Beef and Wool Company in Somerville.

Second. — All neat cattle brought within the limits of this Commonwealth from any place designated in paragraph 1 hereof, except for delivery as provided in the preceding paragraph, must be accompanied by a permit issued by this Board or some member thereof; and you are hereby forbidden to receive for transportation animals other than those designated in such permit.

Third. — If, for any cause, any such neat cattle are received by any of your agents within the limits of this Commonwealth at any place other than the Union stock yards in Watertown, the Boston & Albany stock yards in Brighton or the New England Dressed Beef and Wool Company in Somerville, not accompanied by a permit, as provided in paragraph 2 hereof, you will immediately notify this office, giving the place where said animals were received for shipment, the name of the consignee and destination of said animals. You will not remove said animals or permit them to be removed from the car or vehicle in which

they are contained without a permit from this Board or some member thereof; except that if, by reason of the crowded condition of the car or because of the long confinement of said animals within the same, or for accident or otherwise, it is deemed expedient by you or your agent to unload the same, such animal or animals may be removed by you from said car or vehicle without such permit; but in such case you will notify this office, and you will not allow said animal or animals to go out of the possession of your agent or off of your premises where said animals are unloaded except upon obtaining such permit.

Fourth. — All neat cattle brought within the limits of the premises to Brighton, Watertown and Somerville, designated in paragraph 1 hereof, are hereby declared to be quarantined.

Fifth. — Any person violating the provisions of this order will be punished as provided in section 36 of chapter 408 of the Acts of the year 1899.

This order shall take effect upon the twenty-sixth day of June, 1899.

AUSTIN PETERS, *Chairman*,
LEANDER F. HERRICK, *Secretary*,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

The Board of Cattle Commissioners requires all persons bringing cattle into this State, except calves under six months old or beef cattle for immediate slaughter, to have them tested with tuberculin prior to shipment or after arrival in this State, unless special permission to the contrary is given by this Board. All persons shipping or driving cattle into Massachusetts must have a permit, unless sent by rail to one of the quarantine stations at Brighton, Watertown or Somerville.

The examination of cattle coming from without the State for sale in the markets of Brighton, Watertown and Somerville has been continued throughout the year, and the following tables show the numbers of animals received at the several stations: —

Receipts of Stock at Watertown, from Dec. 15, 1898, to Dec. 15, 1899.

Vermont cattle,	6,116
New Hampshire cattle,	6,403
Massachusetts cattle,	2,454
New York cattle,	27
Western cattle,	54,283

Sheep,	330,419
Swine,	792,781
Veal,	46,628
Horses from the west, of which 42 were exported,	168
Cattle released on certificates,	6,715
Cattle tested,	53
Cattle released after test,	52
Cattle condemned after test,	1

Receipts of Stock at Brighton, from Dec. 15, 1898, to Dec. 15, 1899.

Maine cattle,	12,833
New Hampshire cattle,	2,276
Massachusetts cattle,	12,836
New York cattle,	712
Western cattle,	82,301
Sheep,	25,746
Swine,	812,646
Veal,	38,607
Horses from the west, for export,	50
Cattle released on certificates,	10,658
Cattle tested,	328
Cattle released after test,	317
Cattle condemned after test,	11
Massachusetts cattle in stock barn,	16,724

Receipts of Stock at Somerville, from Dec. 15, 1898, to Dec. 15, 1899.

Maine cattle,	1,030
New Hampshire cattle,	3,851
Vermont cattle,	3,331
Massachusetts cattle,	2,522
New York cattle,	674
Western cattle,	26,166
Sheep,	331,267
Calves,	48,342
Swine,	18,263
Cattle released on certificates,	1,747
Cattle tested,	32
Cattle released after test,	30
Cattle condemned after test,	2

At Somerville, in the year 1898, 799 cattle were released on certificates; during 1899, 1,747, — showing an increase of 948 over the previous year.

Total Stock received at the Three Stations.

Cattle,	234,540
Sheep,	687,432
Swine,	1,623,690
Calves,	133,617
Released on certificates,	19,120
Tested at stations,	413
Released after test,	399
Condemned after test,	14

It will be seen by this report that there have not been as many cattle released on certificates of tuberculin test as last year. In 1898, 19,386 head were released on certificates, a large number of which were young store cattle, while this year there have been but a few of this class. There have been more milch cows than in any previous year, and the demand for these animals is constantly on the increase.

During the past year the Boston & Albany Railroad Company has built a large barn at the Brighton stock yards, which will accommodate 586 cattle, and are now preparing to enlarge it to a capacity of 1,000. The barn accommodations are a great benefit to the stock, as they are all under cover and tied up by themselves.

It is the desire of the Board that this market may be one where buyers may feel when purchasing milch cows that they are reasonably sure of obtaining animals that are healthy and free from tuberculosis. Last year letters were sent to many of the veterinarians who were testing cattle for this market, and from some of the answers received and information derived from other sources it was felt that the work of testing cattle might not be properly done ; therefore, after the Legislature had made the necessary appropriation, an agent was employed to investigate this work and to ascertain how it was being conducted. Upon receiving his report the commission held and tested at various times 317 cattle belonging to different drovers, and found 5 of them tuberculous.

In regard to the admission of cattle from without the State, it is the opinion of this Board that the quarantine stations should be maintained with rules and regulations still

more stringent; otherwise this market would be flooded with tuberculous cattle from other States, for which the purchasers would soon after look to the Commonwealth for payment. While the Board does not feel that the work of testing out-of-the-State cattle is by any means perfect, yet it does feel that there has been a great improvement over the old methods of admitting all classes of cattle within the borders of the State. Many of the buyers affirm that they have had less trouble with their cattle during the last two or three years than ever before; therefore the Board believes it to be good judgment not to relax this work in the slightest degree.

Besides the cattle that have come into the State through the quarantine stations, 6,143 have been brought to other points, being tested with tuberculin prior to shipment or after arrival in this State. There have been 615 permits issued since Dec. 15, 1898.

The second portion of the work includes that coming under the general inspection made by the local inspectors. An order for an examination of the neat stock in the State and the premises on which they were kept was sent out in the following letter to inspectors, October 1: —

To the Inspectors of Animals.

The Board of Cattle Commissioners hereby directs that you shall make a general inspection of the neat stock in your town, and incidentally other farm animals, to commence at once, and to be completed on or before the fifteenth day of November.

The law under which you work is chapter 408 of the Acts of 1899, a copy of which will be sent you, together with the necessary papers for carrying it out. The portion contained in sections 19 to 32 relates especially to your duties, and you should make yourself familiar with it. You will also be provided with a book to carry out the provisions of section 23, with books to carry out the provisions of section 29, and a quarantine book for cases of tuberculosis or other contagious disease among animals.

Cattle are not to be quarantined as tuberculous unless they show enough evidence of disease to make it possible to condemn them on a physical examination, except where the udder of a milch cow is tuberculous; on no account are cattle to be quarantined simply for the purpose of testing them with tuberculin, when they show no physical signs of disease. The only exception to this rule is, that it is the duty of inspectors to quarantine all cattle

brought into the State without a permit from this Board, until the owner furnishes the Cattle Commission with satisfactory certificates of a tuberculin test. Before quarantining any cattle, you should decide upon what cows you are going to quarantine, then send the papers on a number at once, so our agent can see them all on one visit.

By order, AUSTIN PETERS, *Chairman*,
L. F. HERRICK, *Secretary*,
C. A. DENNEN,
Massachusetts Board of Cattle Commissioners.

The following table shows the result of the work done by the inspectors in quarantining cattle. These have been examined by agents of the Board, and those that were found to be diseased have been killed, while those showing no evidence of disease were released.

A few animals were quarantined prior to ordering the general inspection, between June 1 and October 1, but most of those dealt with were quarantined after the 1st of October.

The animals which were killed as a result of this inspection were nearly all badly diseased, and were the ones most likely to be a source of danger to the public health and to other cattle. Most of them were condemned on physical examination.

Included among the number of animals quarantined and released in each place are those where herds were tested at the request of the owner, with the exception of one herd in Newton. These are mentioned again in the table under the head of voluntary request work.

The commission has instructed its agents this year to lay special stress upon the importance of disinfection wherever cows have been taken.

Result of Work done by Inspectors in quarantining Cattle.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
										Condemned.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	Died in Quarantine.
Abington,	249	–	–	–	–	–	–	–	–	–	–	–	–	–
Acton,	1,155	6	–	3	–	–	–	–	3	–	–	–	–	–
Acushnet,	457	–	–	–	–	–	–	–	–	–	–	–	–	–
Adams,	750	–	–	–	–	–	–	–	–	–	–	–	–	–
Agawam,	1,490	4	3	1	–	–	–	–	–	–	–	–	–	–
Alford,	313	–	–	–	–	–	–	–	–	–	–	–	–	–
Amesbury,	461	23	–	5	–	–	1	–	5	–	–	1	11	–
Amherst,	1,983	19	3	13	–	–	2	–	1	–	–	–	–	–
Andover,	1,089	13	1	12	–	–	–	–	–	–	–	–	–	–
Arlington,	246	2	–	2	–	–	–	–	–	–	–	–	–	–
Ashburnham,	471	10	4	5	–	–	–	–	1	–	–	–	–	–
Ashfield,	1,576	–	–	–	–	–	–	–	–	–	–	–	–	–
Ashby,	633	5	1	3	–	–	–	1	–	–	–	–	–	–
Ashland,	408	4	–	3	–	–	–	–	1	–	–	–	–	–
Athol,	599	9	1	6	–	–	2	–	–	–	–	–	–	–
Attleborough,	867	1	–	–	–	–	1	–	–	–	–	–	–	–
Avon,	127	1	1	–	–	–	–	–	–	–	–	–	–	–
Ayer,	102	1	1	–	–	–	–	–	–	–	–	–	–	–

Auburn, ...	897	1	–	1	–	–	–	–	–	–	–	–	–	–
Barnstable, ...	493	4	3	1	–	–	–	–	–	–	–	–	–	–
Barre, ...	2,141	16	6	10	–	–	–	–	–	–	–	–	–	–
Becket, ...	762	–	–	–	–	–	–	–	–	–	–	–	–	–
Bedford, ...	640	2	–	2	–	–	–	–	–	–	–	–	–	–
Belchertown, ...	2,027	6	1	4	–	–	–	–	1	–	–	–	–	–
Bellingham, ...	563	3	1	2	–	–	–	–	–	–	–	–	–	–
Belmont, ...	202	4	2	2	–	–	–	–	–	–	–	–	–	–
Berkley, ...	408	–	–	–	–	–	–	–	–	–	–	–	–	–
Berlin, ...	637	–	–	–	–	–	–	–	–	–	–	–	–	–
Bernardston, ...	810	17	2	9	–	1	1	–	4	–	–	–	–	–
Beverly, ...	561	–	–	–	–	–	–	–	–	–	–	–	–	–
Billerica, ...	904	76	24	27	–	–	–	–	25	–	–	–	–	–
Blackstone, ...	368	–	–	–	–	–	–	–	–	–	–	–	–	–
Blandford, ...	1,173	8	7	1	–	–	–	–	–	–	–	–	–	–
Bolton, ...	829	28	3	20	–	–	–	–	4	–	1	–	–	–
Boston, ...	500	10	–	7	–	–	–	–	2	–	1	–	–	–
Bourne, ...	172	–	–	–	–	–	–	–	–	–	–	–	–	–
Boxborough, ...	633	8	4	4	–	–	–	–	–	–	–	–	–	–
Boylston, ...	837	2	1	1	–	–	–	–	–	–	–	–	–	–
Boxford, ...	583	7	3	4	–	–	–	–	–	–	–	–	–	–
Braintree, ...	436	4	2	2	–	–	–	–	–	–	–	–	–	–
Brewster, ...	171	–	–	–	–	–	–	–	–	–	–	–	–	–
Bridgewater, ...	542	2	1	–	–	–	–	–	1	–	–	–	–	–
Brimfield, ...	1,135	2	–	2	–	–	–	–	–	–	–	–	–	–
Brockton, ...	817	42	16	6	–	–	–	–	–	–	–	3	17	–
Brookfield, ...	808	–	–	–	–	–	–	–	–	–	–	–	–	–
Brookline, ...	379	2	1	–	–	–	–	–	–	–	–	–	1	–
Buckland, ...	863	7	1	2	–	–	1	–	3	–	–	–	–	–
Burlington, ...	536	5	–	5	–	–	–	–	–	–	–	–	–	–
Cambridge, ...	231	–	–	–	–	–	–	–	–	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
										Condemned.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	Died in Quarantine.
Canton,	446	–	–	–	–	–	–	–	–	–	–	–	–	–
Carlisle,	629	34	17	15	–	–	–	–	2	–	–	–	–	–
Carver,	149	–	–	–	–	–	–	–	–	–	–	–	–	–
Charlemont,	913	2	1	1	–	–	–	–	–	–	–	–	–	–
Charlton,	1,786	14	3	10	–	–	–	–	1	–	–	–	–	–
Chatham,	152	5	5	–	–	–	–	–	–	–	–	–	–	–
Chelmsford,	1,200	13	3	10	–	–	–	–	–	–	–	–	–	–
Chelsea,	91	1	1	–	–	–	–	–	–	–	–	–	–	–
Cheshire,	1,170	2	–	–	–	1	1	–	–	–	–	–	–	–
Chester,	773	–	–	–	–	–	–	–	–	–	–	–	–	–
Chesterfield,	842	17	13	2	–	–	1	–	1	–	–	–	–	–
Chicopee,	711	2	–	2	–	–	–	–	–	–	–	–	–	–
Chilmark,	162	–	–	–	–	–	–	–	–	–	–	–	–	–
Clarksburg,	411	–	–	–	–	–	–	–	–	–	–	–	–	–
Clinton,	104	–	–	–	–	–	–	–	–	–	–	–	–	–
Cohasset,	289	1	1	–	–	–	–	–	–	–	–	–	–	–
Colrain,	1,660	1	–	1	–	–	–	–	–	–	–	–	–	–
Concord,	1,567	141	105	28	–	1	1	1	5	–	–	–	–	–

Conway,	1,511	17	1	14	–	2	–	–	–	–	–	–	–	–
Cottage City,	114	–	–	–	–	–	–	–	–	–	–	–	–	–
Cummington,	749	2	–	–	–	–	–	–	2	–	–	–	–	–
Dalton,	534	52	23	6	–	–	–	–	–	–	–	–	23	–
Dana,	279	–	–	–	–	–	–	–	–	–	–	–	–	–
Danvers,	797	8	4	4	–	–	–	–	–	–	–	–	–	–
Dartmouth,	1,595	1	–	1	–	–	–	–	–	–	–	–	–	–
Dedham,	585	5	1	3	–	–	–	–	1	–	–	–	–	–
Deerfield,	1,204	7	2	4	–	–	–	–	1	–	–	–	–	–
Dennis,	201	–	–	–	–	–	–	–	–	–	–	–	–	–
Dighton,	393	–	–	–	–	–	–	–	–	–	–	–	–	–
Douglas,	254	4	1	3	–	–	–	–	–	–	–	–	–	–
Dover,	708	–	–	–	–	–	–	–	–	–	–	–	–	–
Dracut,	1,149	39	14	21	–	1	–	–	1	–	–	–	2	–
Dudley,	1,022	3	–	2	–	–	–	–	1	–	–	–	–	–
Dunstable,	636	9	1	2	–	1	–	–	–	1	–	–	4	–
Duxbury,	316	3	3	–	–	–	–	–	–	–	–	–	–	–
East Bridgewater,	616	1	–	1	–	–	–	–	–	–	–	–	–	–
East Longmeadow,	560	1	1	–	–	–	–	–	–	–	–	–	–	–
Eastham,	161	–	–	–	–	–	–	–	–	–	–	–	–	–
Easthampton,	849	1	–	–	–	–	–	–	1	–	–	–	–	–
Easton,	689	7	4	2	–	–	–	–	1	–	–	–	–	–
Edgartown,	280	–	–	–	–	–	–	–	–	–	–	–	–	–
Egremont,	1,107	–	–	–	–	–	–	–	–	–	–	–	–	–
Enfield,	625	3	1	2	–	–	–	–	–	–	–	–	–	–
Erving,	160	–	–	–	–	–	–	–	–	–	–	–	–	–
Essex,	479	–	–	–	–	–	–	–	–	–	–	–	–	–
Everett,	160	5	–	–	–	–	–	–	–	–	–	–	5	–
Fairhaven,	423	–	–	–	–	–	–	–	–	–	–	–	–	–
Fall River,	596	6	3	1	–	–	–	–	–	–	–	–	2	–
Falmouth,	439	1	–	–	–	–	–	–	1	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Condemned. Sent out of State.	Condemned. Killed, no Award.	Condemned. Killed and paid for.	Released.	Died in Quarantine.
Fitchburg,	655	22	2	16	–	–	–	–	2	–	–	–	2	–
Florida,	400	–	–	–	–	–	–	–	–	–	–	–	–	–
Foxborough,	456	1	1	–	–	–	–	–	–	–	–	–	–	–
Framingham,	1,049	–	–	–	–	–	–	–	–	–	–	–	–	–
Franklin,	780	9	1	7	–	–	–	–	1	–	–	–	–	–
Freetown,	323	1	–	1	–	–	–	–	–	–	–	–	–	–
Gardner,	585	11	–	2	–	–	–	–	–	–	–	–	9	–
Gay Head,	53	–	–	–	–	–	–	–	–	–	–	–	–	–
Georgetown,	269	–	–	–	–	–	–	–	–	–	–	–	–	–
Gill,	675	10	5	3	–	–	–	–	2	–	–	–	–	–
Gloucester,	486	10	1	–	–	–	–	–	–	–	–	–	9	–
Goshen,	377	6	1	5	–	–	–	–	–	–	–	–	–	–
Gosnold,	45	–	–	–	–	–	–	–	–	–	–	–	–	–
Grafton,	1,141	19	3	12	–	–	–	–	4	–	–	–	–	–
Granby,	1,532	9	5	1	–	–	–	–	3	–	–	–	–	–
Granville,	766	–	–	–	–	–	–	–	–	–	–	–	–	–
Great Barrington,	1,516	–	–	–	–	–	–	–	–	–	–	–	–	–
Greenfield,	1,181	50	24	13	–	1	1	–	11	–	–	–	–	–

Greenwich,	399	2	–	2	–	–	–	–	–	–	–	–	–	–
Groton,	1,044	8	3	2	–	–	–	–	–	2	–	1	–	–
Groveland,	241	–	–	–	–	–	–	–	–	–	–	–	–	–
Hadley,	1,697	4	1	3	–	–	–	–	–	–	–	–	–	–
Halifax,	144	1	1	–	–	–	–	–	–	–	–	–	–	–
Hamilton,	332	1	–	1	–	–	–	–	–	–	–	–	–	–
Hampden,	652	–	–	–	–	–	–	–	–	–	–	–	–	–
Hancock,	735	–	–	–	–	–	–	–	–	–	–	–	–	–
Hanover,	273	2	1	–	–	1	–	–	–	–	–	–	–	–
Hanson,	169	–	–	–	–	–	–	–	–	–	–	–	–	–
Hardwick,	1,989	7	4	3	–	–	–	–	–	–	–	–	–	–
Harvard,	1,456	6	3	1	–	–	–	–	2	–	–	–	–	–
Harwich,	209	–	–	–	–	–	–	–	–	–	–	–	–	–
Hatfield,	429	19	1	3	–	–	–	–	4	–	–	–	11	–
Haverhill,	1,335	18	2	15	–	–	–	–	1	–	–	–	–	–
Hawley,	721	–	–	–	–	–	–	–	–	–	–	–	–	–
Heath,	920	38	32	3	–	1	–	–	2	–	–	–	–	–
Hingham,	525	1	1	–	–	–	–	–	–	–	–	–	–	–
Hinsdale,	722	–	–	–	–	–	–	–	–	–	–	–	–	–
Holden,	1,086	2	–	2	–	–	–	–	–	–	–	–	–	–
Holbrook,	181	1	–	1	–	–	–	–	–	–	–	–	–	–
Holland,	118	–	–	–	–	–	–	–	–	–	–	–	–	–
Holliston,	700	–	–	–	–	–	–	–	–	–	–	–	–	–
Holyoke,	571	4	–	2	–	–	–	–	2	–	–	–	–	–
Hopedale,	110	1	–	1	–	–	–	–	–	–	–	–	–	–
Hopkinton,	760	11	2	7	–	–	–	–	2	–	–	–	–	–
Hubbardston,	985	6	1	3	–	–	–	–	2	–	–	–	–	–
Hudson,	448	–	–	–	–	–	–	–	–	–	–	–	–	–
Hull,	54	–	–	–	–	–	–	–	–	–	–	–	–	–
Huntington,	584	–	–	–	–	–	–	–	–	–	–	–	–	–
Hyde Park,	132	2	1	1	–	–	–	–	–	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
										Condemned.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	Died in Quarantine.
Ipswich,	900	2	–	–	–	–	–	–	2	–	–	–	–	–
Kingston,	254	1	–	1	–	–	–	–	–	–	–	–	–	–
Lakeville,	348	1	–	1	–	–	–	–	–	–	–	–	–	–
Lancaster,	616	6	3	3	–	–	–	–	–	–	–	–	–	–
Lanesborough,	988	–	–	–	–	–	–	–	–	–	–	–	–	–
Lawrence,	109	–	–	–	–	–	–	–	–	–	–	–	–	–
Lee,	801	88	14	3	–	–	–	–	–	–	–	–	71	–
Leicester,	621	2	–	2	–	–	–	–	–	–	–	–	–	–
Lenox,	621	3	2	1	–	–	–	–	–	–	–	–	–	–
Leominster,	889	13	3	7	–	1	–	1	1	–	–	–	–	–
Leverett,	525	–	–	–	–	–	–	–	–	–	–	–	–	–
Lexington,	1,299	2	–	2	–	–	–	–	–	–	–	–	–	–
Leyden,	556	35	13	3	–	–	3	–	16	–	–	–	–	–
Lincoln,	981	2	4	1	–	–	–	–	1	–	–	–	–	–
Littleton,	1,445	11	–	5	–	–	–	–	1	–	–	–	1	–
Longmeadow,	236	13	6	5	–	–	–	1	1	–	–	–	–	–
Lowell,	273	16	4	3	–	–	–	–	1	–	2	–	5	1
Ludlow,	1,003	8	2	5	–	–	–	–	1	–	–	–	–	–

Lunenburg,	956	50	4	21	-	-	-	1	-	-	-	-	24	-
Lynn,	278	9	1	2	-	-	1	-	4	-	-	-	1	-
Lynnfield,	317	-	-	-	-	-	-	-	-	-	-	-	-	-
Malden,	188	-	-	-	-	-	-	-	-	-	-	-	-	-
Manchester,	95	1	-	1	-	-	-	-	-	-	-	-	-	-
Mansfield,	238	2	2	-	-	-	-	-	-	-	-	-	-	-
Marblehead,	270	-	-	-	-	-	-	-	-	-	-	-	-	-
Marion,	128	-	-	-	-	-	-	-	-	-	-	-	-	-
Marlborough,	965	2	-	1	-	-	-	-	1	-	-	-	-	-
Marshfield,	394	2	-	1	-	-	-	-	1	-	-	-	-	-
Mashpee,	26	-	-	-	-	-	-	-	-	-	-	-	-	-
Mattapoisett,	249	-	-	-	-	-	-	-	-	-	-	-	-	-
Maynard,	274	-	-	-	-	-	-	-	-	-	-	-	-	-
Medfield,	595	-	-	-	-	-	-	-	-	-	-	-	-	-
Medford,	337	-	-	-	-	-	-	-	-	-	-	-	-	-
Medway,	429	-	-	-	-	-	-	-	-	-	-	-	-	-
Melrose,	195	-	-	-	-	-	-	-	-	-	-	-	-	-
Mendon,	545	4	1	2	-	-	-	-	1	-	-	-	-	-
Merrimac,	290	1	-	-	-	-	-	-	1	-	-	-	-	-
Methuen,	1,353	28	22	6	-	-	-	-	-	-	-	-	-	-
Middleborough,	694	4	-	3	-	-	1	-	-	-	-	-	-	-
Middlefield,	595	4	3	1	-	-	-	-	-	-	-	-	-	-
Middleton,	258	-	-	-	-	-	-	-	-	-	-	-	-	-
Milford,	393	3	-	1	-	-	-	1	1	-	-	-	-	-
Millbury,	859	13	2	9	-	-	-	-	2	-	-	-	-	-
Millis,	526	18	17	1	-	-	-	-	-	-	-	-	-	-
Milton,	858	2	1	1	-	-	-	-	-	-	-	-	-	-
Monroe,	143	-	-	-	-	-	-	-	-	-	-	-	-	-
Monson,	1,478	7	3	4	-	-	-	-	-	-	-	-	-	-
Montague,	926	52	19	1	-	1	3	-	27	1	-	-	-	-
Monterey,	529	-	-	-	-	-	-	-	-	-	-	-	-	-

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Condemned. Sent out of State.	Condemned. Killed, no Award.	Condemned. Killed and paid for.	Released.	Died in Quarantine.
Montgomery,	443	1	-	-	-	-	-	-	1	-	-	-	-	-
Mount Washington,	83	-	-	-	-	-	-	-	-	-	-	-	-	-
Nahant,	33	-	-	-	-	-	-	-	-	-	-	-	-	-
Nantucket,	431	-	-	-	-	-	-	-	-	-	-	-	-	-
Natick,	540	14	2	6	-	-	-	-	6	-	-	-	-	-
Needham,	862	13	-	-	-	-	-	-	-	-	-	2	11	-
New Ashford,	162	-	-	-	-	-	-	-	-	-	-	-	-	-
New Bedford,	636	1	-	1	-	-	-	-	-	-	-	-	-	-
New Braintree,	1,552	-	-	-	-	-	-	-	-	-	-	-	-	-
New Marlborough,	1,661	1	1	-	-	-	-	-	-	-	-	-	-	-
New Salem,	455	1	1	-	-	-	-	-	-	-	-	-	-	-
Newbury,	1,142	-	-	-	-	-	-	-	-	-	-	-	-	-
Newburyport,	262	-	-	-	-	-	-	-	-	-	-	-	-	-
Newton,	1,173	5	1	3	-	-	-	1	-	-	-	-	-	-
Norfolk,	341	1	-	1	-	-	-	-	-	-	-	-	-	-
North Adams,	534	1	1	-	-	-	-	-	-	-	-	-	-	-
North Andover,	1,363	34	6	21	-	-	-	-	3	-	-	-	4	-
North Attleborough,	601	2	-	1	-	-	-	-	1	-	-	-	-	-

North Brookfield,	1,074	19	6	13	–	–	–	–	–	–	–	–	–	–
North Reading,	319	5	2	3	–	–	–	–	–	–	–	–	–	–
Northampton,	1,099	8	1	5	–	–	–	–	2	–	–	–	–	–
Northborough,	965	4	1	3	–	–	–	–	–	–	–	–	–	–
Northbridge,	435	7	–	4	–	–	–	–	3	–	–	–	–	–
Northfield,	930	16	5	5	–	1	1	–	4	–	–	–	–	–
Norton,	343	–	–	–	–	–	–	–	–	–	–	–	–	–
Norwell,	283	–	–	–	–	–	–	–	–	–	–	–	–	–
Norwood,	351	5	1	3	–	–	–	–	1	–	–	–	–	–
Oakham,	736	3	2	1	–	–	–	–	–	–	–	–	–	–
Orange,	862	13	1	7	–	–	1	–	4	–	–	–	–	–
Orleans,	160	–	–	–	–	–	–	–	–	–	–	–	–	–
Otis,	556	–	–	–	–	–	–	–	–	–	–	–	–	–
Oxford,	695	3	1	2	–	–	–	–	–	–	–	–	–	–
Palmer,	839	7	5	2	–	–	–	–	–	–	–	–	–	–
Paxton,	414	3	2	1	–	–	–	–	–	–	–	–	–	–
Peabody,	635	12	–	–	–	–	–	–	–	–	–	–	12	–
Pelham,	217	–	–	–	–	–	–	–	–	–	–	–	–	–
Pembroke,	188	2	–	2	–	–	–	–	–	–	–	–	–	–
Pepperell,	795	8	4	2	–	–	–	–	1	–	–	–	1	–
Peru,	434	–	–	–	–	–	–	–	–	–	–	–	–	–
Petersham,	676	–	–	–	–	–	–	–	–	–	–	–	–	–
Phillipston,	419	1	–	–	1	–	–	–	–	–	–	–	–	–
Pittsfield,	1,413	–	–	–	–	–	–	–	–	–	–	–	–	–
Plainfield,	667	–	–	–	–	–	–	–	–	–	–	–	–	–
Plymouth,	377	4	1	2	–	–	–	–	1	–	–	–	–	–
Plympton,	120	–	–	–	–	–	–	–	–	–	–	–	–	–
Prescott,	434	1	1	–	–	–	–	–	–	–	–	–	–	–
Princeton,	1,295	17	2	8	–	–	–	–	7	–	–	–	–	–
Provincetown,	68	–	–	–	–	–	–	–	–	–	–	–	–	–
Quincy,	677	–	–	–	–	–	–	–	–	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Condemned. Sent out of State.	Condemned. Killed, no Award.	Condemned. Killed and paid for.	Released.	Died in Quarantine.
Randolph,	215	–	–	–	–	–	–	–	–	–	–	–	–	–
Raynham,	455	3	1	2	–	–	–	–	–	–	–	–	–	–
Reading,	427	1	–	–	–	–	–	–	–	–	–	–	1	–
Rehoboth,	1,232	29	23	4	–	–	–	–	–	2	–	–	–	–
Revere,	120	–	–	–	–	–	–	–	–	–	–	–	–	–
Richmond,	467	–	–	–	–	–	–	–	–	–	–	–	–	–
Rochester,	221	–	–	–	–	–	–	–	–	–	–	–	–	–
Rockland,	203	1	–	1	–	–	–	–	–	–	–	–	–	–
Rockport,	180	–	–	–	–	–	–	–	–	–	–	–	–	–
Rowe,	573	2	2	–	–	–	–	–	–	–	–	–	–	–
Rowley,	475	1	–	–	–	–	–	–	–	–	–	–	1	–
Royalston,	628	6	–	6	–	–	–	–	–	–	–	–	–	–
Russell,	189	3	2	–	–	–	–	–	1	–	–	–	–	–
Rutland,	955	9	1	5	–	–	–	–	3	–	–	–	–	–
Salisbury,	464	10	6	2	–	–	–	–	–	–	–	–	2	–
Salem,	324	5	2	–	–	–	–	–	2	–	–	–	1	–
Sandisfield,	885	1	1	–	–	–	–	–	–	–	–	–	–	–
Sandwich,	204	–	–	–	–	–	–	–	–	–	–	–	–	–

Saugus,	724	1	1	–	–	–	–	–	–	–	–	–	–	–
Savoy,	671	–	–	–	–	–	–	–	–	–	–	–	–	–
Scituate,	336	–	–	–	–	–	–	–	–	–	–	–	–	–
Seekonk,	1,143	2	1	1	–	–	–	–	–	–	–	–	–	–
Sharon,	343	–	–	–	–	–	–	–	–	–	–	–	–	–
Sheffield,	1,865	–	–	–	–	–	–	–	–	–	–	–	–	–
Shelburne,	1,438	19	4	5	–	–	–	–	10	–	–	–	–	–
Shutesbury,	142	–	–	–	–	–	–	–	–	–	–	–	–	–
Sherborn,	763	21	11	7	–	1	–	–	2	–	–	–	–	–
Shirley,	404	1	–	1	–	–	–	–	–	–	–	–	–	–
Shrewsbury,	1,264	56	42	–	–	–	6	–	8	–	–	–	–	–
Somerset,	470	–	–	–	–	–	–	–	–	–	–	–	–	–
Somerville,	271	1	–	1	–	–	–	–	–	–	–	–	–	–
South Hadley,	1,180	3	2	1	–	–	–	–	–	–	–	–	–	–
Southampton,	1,058	4	2	2	–	–	–	–	–	–	–	–	–	–
Southborough,	1,175	–	–	–	–	–	–	–	–	–	–	–	–	–
Southbridge,	808	1	–	1	–	–	–	–	–	–	–	–	–	–
Southwick,	935	–	–	–	–	–	–	–	–	–	–	–	–	–
Spencer,	1,459	2	–	2	–	–	–	–	–	–	–	–	–	–
Springfield,	414	3	–	2	–	–	–	–	1	–	–	–	–	–
Sterling,	1,744	37	4	20	–	1	–	–	12	–	–	–	–	–
Stockbridge,	879	1	1	–	–	–	–	–	–	–	–	–	–	–
Stoneham,	251	–	–	–	–	–	–	–	–	–	–	–	–	–
Stoughton,	352	7	5	–	–	–	–	–	2	–	–	–	–	–
Stow,	1,080	16	11	5	–	–	–	–	–	–	–	–	–	–
Sturbridge,	738	1	–	–	–	–	–	–	1	–	–	–	–	–
Sudbury,	1,365	2	1	1	–	–	–	–	–	–	–	–	–	–
Sunderland,	887	14	8	6	–	–	–	–	–	–	–	–	–	–
Sutton,	1,009	17	6	10	–	1	–	–	–	–	–	–	–	–
Swampscott.	115	–	–	–	–	–	–	–	–	–	–	–	–	–
Swanzey,	1,001	1	–	1	–	–	–	–	–	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Condemned. Sent out of State.	Condemned. Killed, no Award.	Condemned. Killed and paid for.	Released.	Died in Quarantine.
Taunton,	855	4	-	1	-	-	-	-	1	-	-	-	2	-
Templeton,	563	9	7	2	-	-	-	-	-	-	-	-	-	-
Tewksbury,	607	7	1	3	-	-	-	-	3	-	-	-	-	-
Tisbury,	109	-	-	-	-	-	-	-	-	-	-	-	-	-
Tolland,	425	-	-	-	-	-	-	-	-	-	-	-	-	-
Topsfield,	679	12	-	-	-	-	-	-	2	-	-	-	10	-
Townsend,	418	11	1	10	-	-	-	-	-	-	-	-	-	-
Truro,	181	-	-	-	-	-	-	-	-	-	-	-	-	-
Tyngsborough,	500	10	1	5	-	-	-	-	-	-	-	-	4	-
Tyringham,	494	1	-	1	-	-	-	-	-	-	-	-	-	-
Upton,	569	3	-	3	-	-	-	-	-	-	-	-	-	-
Uxbridge,	742	2	-	2	-	-	-	-	-	-	-	-	-	-
Wakefield,	288	2	-	2	-	-	-	-	-	-	-	-	-	-
Wales,	282	-	-	-	-	-	-	-	-	-	-	-	-	-
Walpole,	551	4	3	1	-	-	-	-	-	-	-	-	-	-
Waltham,	876	33	24	3	-	-	1	2	3	-	-	-	-	-
Ware,	956	5	4	1	-	-	-	-	-	-	-	-	-	-
Wareham,	205	1	1	-	-	-	-	-	-	-	-	-	-	-

Warren,	667	2	1	1	–	–	–	–	–	–	–	–	–	–
Warwick,	284	–	–	–	–	–	–	–	–	–	–	–	–	–
Washington,	547	–	–	–	–	–	–	–	–	–	–	–	–	–
Watertown,	392	5	1	1	–	–	–	–	–	–	–	–	3	–
Wayland,	824	33	24	6	–	1	–	–	2	–	–	–	–	–
Webster,	314	–	–	–	–	–	–	–	–	–	–	–	–	–
Wellesley,	321	1	–	1	–	–	–	–	–	–	–	–	–	–
Wellfleet,	93	–	–	–	–	–	–	–	–	–	–	–	–	–
Wendell,	204	–	–	–	–	–	–	–	–	–	–	–	–	–
Wenham,	366	–	–	–	–	–	–	–	–	–	–	–	–	–
West Boylston,	817	1	–	1	–	–	–	–	–	–	–	–	–	–
West Bridgewater,	782	5	4	1	–	–	–	–	–	–	–	–	–	–
West Brookfield,	1,226	8	2	5	–	1	–	–	–	–	–	–	–	–
West Newbury,	931	9	2	1	–	–	–	–	6	–	–	–	–	–
West Springfield,	841	2	1	–	–	–	–	–	1	–	–	–	–	–
West Stockbridge,	439	–	–	–	–	–	–	–	–	–	–	–	–	–
West Tisbury,	214	–	–	–	–	–	–	–	–	–	–	–	–	–
Westborough,	1,222	1	–	–	–	–	–	–	1	–	–	–	–	–
Westfield,	1,239	1	1	–	–	–	–	–	–	–	–	–	–	–
Westford,	998	4	–	4	–	–	–	–	–	–	–	–	–	–
Westhampton,	606	1	–	–	–	–	–	–	1	–	–	–	–	–
Westminster,	645	12	5	7	–	–	–	–	–	–	–	–	–	–
Weston,	1,217	149	105	8	–	–	2	–	33	–	1	–	–	–
Westport,	1,309	8	–	3	–	–	–	–	5	–	–	–	–	–
Westwood,	710	62	60	–	–	–	–	–	2	–	–	–	–	–
Weymouth,	587	2	1	–	–	–	–	–	1	–	–	–	–	–
Whately,	822	10	5	3	–	–	–	–	2	–	–	–	–	–
Whitman,	293	–	–	–	–	–	–	–	–	–	–	–	–	–
Wilbraham,	917	–	–	–	–	–	–	–	–	–	–	–	–	–
Williamsburg,	745	3	1	1	–	–	–	–	1	–	–	–	–	–
Williamstown,	1,489	3	1	1	–	–	–	–	1	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Concluded.

CITY OR TOWN.	Massachusetts Cattle.									Cattle from out of State.				
										Condemned.				
	Neat Cattle assessed.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	Died in Quarantine.
Wilmington,	291	17	2	12	–	–	–	1	2	–	–	–	–	–
Winchendon,	527	2	–	1	–	–	–	–	–	–	–	–	1	–
Winchester,	214	–	–	–	–	–	–	–	–	–	–	–	–	–
Windsor,	825	3	2	1	–	–	–	–	–	–	–	–	–	–
Winthrop,	73	3	2	–	1	–	–	–	–	–	–	–	–	–
Woburn,	317	6	1	4	–	–	–	–	1	–	–	–	–	–
Worcester,	2,066	9	2	6	–	–	–	–	1	–	–	–	–	–
Worthington,	1,045	13	6	–	–	–	–	–	–	–	1	–	6	–
Wrentham,	597	3	–	1	–	–	–	–	–	–	1	–	1	–
Yarmouth,	157	–	–	–	–	–	–	–	–	–	–	–	–	–
Totals,	229,860	2,424	978	792	2	18	31	10	*314	6	6	7	259	1

* This includes three animals held for re-test.

Section 29 of chapter 408 of the Acts of the year 1899 requires the inspectors, in addition to their inspection of animals for contagious diseases, to examine the barns, stables and other enclosures in which any cattle are kept, with reference to their situation, cleanliness, light, ventilation and water supply; to make a detailed report, with names and residences of owners, to the Board of Cattle Commissioners, which shall embody the same in its annual report to the Legislature.

In accordance with the above provision, the Board ordered the inspectors in the various cities and towns of the Commonwealth to make an examination of the different premises where neat cattle are kept, and to make their return on or before November 15. A large majority of the inspectors made a very careful inspection and report; but in some of the towns examination of many stables was omitted, and the inspectors in the following towns have sent in no returns of inspection of stables: —

Billerica.	Hudson.	North Adams.
Brookline.	Lawrence.	Petersham.
Canton.	Lowell.	Richmond.
Chelmsford.	Maynard.	Rockland.
Dracut.	Middlefield.	South Hadley.
Framingham.	Montgomery.	Waltham.
Gardner.	New Braintree.	Ware.
Haverhill.	Newbury.	

From the returns of the above inspection, sent to this office, the following table has been compiled: —

Inspection of Barns, Stables, etc., in which Cattle are kept.

	Number of Stables inspected.	Number of Stables on the Ground.	Number of Stables over Cellars.	Number of Stables in Cellars.	Number of Stables with Good Light.	Number of Stables with Bad Light.	Number of Stables with no Light.	Number of Stables with Good Ventilation.	Number of Stables with Bad Ventilation.	Number of Stables with no Ventilation.	Number of Stables with Good Water Supply.	Number of Stables with Fair Water Supply.	Number of Stables with Bad Water Supply.	Number of Stables kept Clean.	Number of Stables kept Unclean.
Abington,	127	43	79	5	125	2	–	125	2	–	120	7	–	123	4
Acton,	135	19	115	1	111	24	–	134	1	–	104	4	27	124	11
Acushnet,	124	18	103	3	80	44	–	110	14	–	114	4	6	109	15
Adams,	57	31	18	8	21	28	8	40	14	3	52	5	–	48	9
Agawam,	110	66	28	16	52	54	4	81	28	1	82	24	4	101	9
Alford,	41	25	2	14	29	5	7	41	–	–	26	15	–	39	2
Amesbury,	48	8	38	2	42	6	–	45	3	–	40	5	3	45	3
Amherst,	146	69	66	11	64	62	20	115	19	12	94	26	26	119	27
Andover,	104	14	89	1	59	41	4	99	5	–	88	13	3	98	6
Arlington,	104	36	56	12	89	11	4	94	7	3	104	–	–	102	2
Ashburnham,	138	61	67	10	78	58	2	126	12	–	137	–	1	103	35
Ashfield,	133	65	68	–	71	35	27	133	–	–	44	66	23	90	43
Ashby,	122	24	98	–	89	33	–	117	5	–	75	25	22	119	3
Ashland,	87	17	69	1	45	41	1	69	17	1	75	11	1	75	12
Athol,	79	35	39	5	43	30	6	61	18	–	67	12	–	44	35
Attleborough,	143	32	110	1	133	6	4	130	7	6	126	10	7	142	1
Avon,	11	6	5	–	8	3	–	9	2	–	10	1	–	10	1
Auburn,	37	5	30	2	35	2	–	34	3	–	36	1	–	36	1
Ayer,	33	1	–	32	25	5	3	28	5	–	30	–	3	31	2
Barnstable,	290	131	115	44	179	82	29	239	42	9	158	128	4	248	42
Barre,	76	13	63	–	65	6	5	74	2	–	70	4	2	71	5
Becket,	107	11	15	81	57	19	31	106	1	–	103	4	–	98	9

Bedford,	75	11	24	40	51	24	-	74	1	-	64	11	-	68	7
Belchertown,	155	3	-	152	122	33	-	154	1	-	96	59	-	155	-
Bellingham,	118	30	85	3	47	61	10	74	42	2	81	36	1	80	38
Belmont,	22	4	4	14	17	5	-	15	7	-	22	-	-	22	-
Berkley,	67	3	61	3	60	5	2	67	-	-	66	-	1	67	-
Berlin,	89	26	59	4	64	19	6	89	-	-	84	5	-	87	2
Bernardston,	63	28	33	2	27	23	13	37	17	9	53	9	1	49	14
Beverly,	5	-	4	1	5	-	-	4	1	-	5	-	-	5	-
Billerica,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blackstone,	21	1	20	-	20	1	-	21	-	-	12	9	-	21	-
Blandford,	173	117	27	29	80	51	42	165	8	-	173	-	-	162	11
Bolton,	72	10	62	-	69	3	-	65	7	-	67	5	-	68	4
Boston,	52	18	26	8	17	35	-	22	30	-	49	3	-	23	29
Bourne,	35	21	14	-	30	2	3	34	1	-	29	6	-	35	-
Boxborough,	53	3	50	-	39	2	12	48	5	-	48	-	5	43	10
Boxford,	79	22	57	-	46	25	8	62	14	3	59	17	3	70	9
Boylston,	76	-	-	76	68	5	3	72	-	4	65	8	3	72	4
Braintree,	84	35	45	4	60	19	5	73	8	3	76	5	3	67	17
Brewster,	89	56	24	9	73	16	-	79	10	-	89	-	-	77	12
Bridgewater,	128	23	93	12	54	62	12	58	70	-	99	29	-	106	22
Brimfield,	119	44	68	7	72	42	5	117	2	-	112	7	-	116	3
Brockton,	140	56	83	1	106	30	4	120	14	6	126	3	11	122	18
Brookfield,	154	66	81	7	89	31	34	107	37	10	140	14	-	110	44
Brookline,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buckland,	129	44	71	14	125	3	1	117	10	2	121	8	-	119	10
Burlington,	54	-	54	-	49	5	-	49	5	-	54	-	-	54	-
Cambridge,	17	7	9	1	15	2	-	17	-	-	17	-	-	17	-
Canton,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carlisle,	76	21	55	-	60	16	-	58	18	-	74	2	-	57	19
Carver,	70	19	48	3	55	10	5	65	5	-	61	9	-	64	6
Charlemont,	93	-	-	93	54	33	6	91	2	-	86	7	-	90	3

Inspection of Barns, Stables, etc., in which Cattle are kept — Continued.

	Number of Stables inspected.	Number of Stables on the Ground.	Number of Stables over Cellars.	Number of Stables in Cellars.	Number of Stables with Good Light.	Number of Stables with Bad Light.	Number of Stables with no Light.	Number of Stables with Good Ventilation.	Number of Stables with Bad Ventilation.	Number of Stables with no Ventilation.	Number of Stables with Good Water Supply.	Number of Stables with Fair Water Supply.	Number of Stables with Bad Water Supply.	Number of Stables kept Clean.	Number of Stables kept Unclean.
Charlton, . . .	200	118	73	9	187	7	6	191	4	5	195	5	–	196	4
Chatham, . . .	94	18	67	9	46	16	32	77	11	6	82	7	5	71	23
Chelmsford, . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chelsea, . . .	20	15	5	–	18	2	–	19	1	–	18	2	–	20	–
Cheshire, . . .	77	53	13	11	34	19	24	58	13	6	74	3	–	71	6
Chester, . . .	100	1	–	99	64	36	–	89	11	–	78	22	–	93	7
Chesterfield, . .	148	70	33	45	80	47	21	139	9	–	118	29	1	132	16
Chicopee, . . .	77	20	11	46	57	20	–	69	8	–	77	–	–	69	8
Chilmark, . .	52	17	35	–	27	25	–	52	–	–	49	3	–	50	2
Clarksburg, . .	81	41	22	18	33	41	7	63	15	3	76	5	–	62	19
Clinton, . . .	12	5	7	–	12	–	–	12	–	–	12	–	–	12	–
Cohasset, . . .	123	71	52	–	80	43	–	120	2	1	121	2	–	115	8
Colrain, . . .	194	113	73	8	151	36	7	190	4	–	190	4	–	190	4
Concord, . . .	110	10	98	2	82	27	1	99	11	–	90	10	10	102	8
Conway, . . .	88	37	35	16	82	6	–	85	3	–	82	6	–	88	–
Cottage City, . .	43	21	22	–	23	16	4	43	–	–	29	4	10	40	3
Cummington, . .	97	29	46	22	72	8	17	92	3	2	95	2	–	94	3
Dalton, . . .	76	7	2	67	60	16	–	66	10	–	75	1	–	76	–
Dana, . . .	51	28	20	3	46	5	–	47	4	–	41	10	–	49	2
Danvers, . . .	65	10	54	1	61	3	1	61	3	1	63	1	1	63	2
Dartmouth, . .	226	30	59	137	162	54	10	206	16	4	139	87	–	208	18
Dedham, . . .	31	11	18	2	29	2	–	24	7	–	27	3	1	27	4

Deerfield,	66	41	18	7	31	22	13	61	5	-	53	9	4	58	8
Dennis,	105	68	34	3	67	27	11	66	35	4	99	6	-	92	13
Dighton,	111	31	76	4	106	4	1	111	-	-	93	16	2	110	1
Douglas,	105	23	78	4	95	10	-	103	2	-	100	5	-	100	5
Dover,	77	15	56	6	51	25	1	65	12	-	61	13	3	62	15
Dracut,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dudley,	95	22	66	7	58	27	10	80	7	8	81	7	7	79	16
Dunstable,	71	4	-	67	37	27	7	60	7	4	53	16	2	55	16
Duxbury,	124	50	64	10	85	30	9	117	6	1	120	4	-	105	19
East Bridgewater,	176	67	103	6	149	15	12	176	-	-	169	7	-	167	9
East Longmeadow,	109	-	-	109	62	31	16	100	9	-	88	21	-	93	16
Eastham,	66	45	19	2	62	1	3	64	2	-	65	1	-	65	1
Easthampton,	142	104	13	25	117	21	4	142	-	-	98	42	2	134	8
Easton,	181	62	111	8	105	66	10	167	12	2	170	10	1	169	12
Edgartown,	67	41	26	-	11	18	38	60	6	1	63	4	-	60	7
Egremont,	93	59	-	34	61	19	13	80	13	-	65	28	-	92	1
Enfield,	88	3	2	83	77	7	4	87	1	-	71	11	6	86	2
Erving,	36	3	28	5	33	3	-	35	1	-	30	3	3	35	1
Essex,	77	42	33	2	66	11	-	74	3	-	48	26	3	74	3
Everett,	17	8	8	1	14	1	2	15	1	1	15	2	-	15	2
Fairhaven,	107	43	64	-	62	35	10	82	25	-	90	11	6	92	15
Fall River,	119	58	30	31	111	2	6	108	6	5	119	-	-	113	6
Falmouth,	153	57	54	42	84	42	27	119	13	21	64	81	8	140	13
Fitchburg,	135	47	80	8	65	52	18	83	37	15	109	15	11	78	57
Florida,	59	32	9	18	55	-	4	59	-	-	59	-	-	59	-
Foxborough,	141	37	97	7	81	47	13	129	12	-	116	25	-	126	15
Framingham,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Franklin,	141	38	98	5	105	36	-	125	13	3	120	13	8	139	2
Freetown,	123	31	81	11	56	32	35	89	34	-	121	2	-	118	5
Gardner,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gay Head,	21	15	2	4	16	-	5	21	-	-	21	-	-	21	-

Inspection of Barns, Stables, etc., in which Cattle are kept — Continued.

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Georgetown,	87	39	43	5	65	18	4	84	3	–	87	–	–	86	1
Gill,	63	31	22	10	30	23	10	59	4	–	62	1	–	59	4
Gloucester,	139	90	42	7	100	36	3	133	6	–	139	–	–	139	–
Goshen,	50	18	25	7	34	14	2	47	3	–	50	–	–	49	1
Gosnold,	10	7	3	–	10	–	–	9	1	–	10	–	–	10	–
Grafton,	79	5	66	8	59	19	1	60	19	–	72	7	–	52	27
Granby,	129	17	112	–	122	4	3	125	4	–	120	6	3	123	6
Granville,	117	10	104	3	61	50	6	115	2	–	111	5	1	111	6
Great Barrington,	103	41	5	57	49	48	6	61	40	2	100	3	–	69	34
Greenfield,	55	24	27	4	32	19	4	49	6	–	54	1	–	48	7
Greenwich,	76	38	36	2	70	–	6	76	–	–	76	–	–	76	–
Groton,	142	14	74	54	87	50	5	94	48	–	112	–	30	98	53
Groveland,	64	22	40	2	51	7	6	62	2	–	62	2	–	61	3
Hadley,	299	213	57	29	158	64	77	267	32	–	221	41	37	265	34
Halifax,	62	43	17	2	29	33	–	61	1	–	59	3	–	59	3
Hamilton,	62	23	35	4	50	12	–	58	4	–	50	8	4	58	4
Hampden,	90	53	32	5	84	6	–	89	1	–	80	10	–	85	5
Hancock,	57	56	1	–	38	19	–	57	–	–	51	6	–	56	1
Hanover,	126	42	79	5	117	9	–	124	2	–	123	–	3	119	7
Hanson,	99	25	68	6	92	7	–	98	1	–	88	8	3	96	3
Hardwick,	128	42	79	7	77	31	20	99	23	6	112	16	–	88	40
Harvard,	130	18	108	4	110	12	8	114	8	8	115	15	–	108	22

Harwich,	138	14	112	12	103	35	–	138	–	–	131	7	–	132	6
Hatfield,	148	139	6	3	135	13	–	146	2	–	140	6	2	148	–
Haverhill,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hawley,	104	40	46	18	89	15	–	102	2	–	92	8	4	100	4
Heath,	88	17	23	48	76	10	2	83	5	–	87	1	–	82	6
Hingham,	189	66	104	19	175	12	2	187	2	–	170	19	–	187	2
Hinsdale,	78	26	12	40	41	31	6	75	3	–	51	27	–	78	–
Holbrook,	84	1	76	7	73	8	3	84	–	–	68	16	–	80	4
Holden,	88	–	–	88	87	1	–	56	32	–	71	17	–	85	3
Holland,	33	–	–	33	14	12	7	32	1	–	24	9	–	33	–
Holliston,	106	21	83	2	101	5	–	101	5	–	86	20	–	95	11
Holyoke,	50	15	19	16	48	2	–	46	4	–	48	–	2	47	3
Hopedale,	30	3	24	3	27	3	–	30	–	–	30	–	–	30	–
Hopkinton,	138	24	112	2	111	27	–	105	23	10	120	10	8	113	25
Hubbardston,	46	10	35	1	45	1	–	45	1	–	41	5	–	45	1
Hudson,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hull,	19	7	9	3	18	1	–	18	1	–	19	–	–	18	1
Huntington,	110	3	–	107	80	19	11	110	–	–	105	4	1	107	3
Hyde Park,	18	–	–	18	17	1	–	11	7	–	16	2	–	12	6
Ipswich,	148	78	67	3	126	22	–	144	4	–	140	8	–	146	2
Kingston,	80	2	–	78	58	14	8	77	3	–	61	19	–	75	5
Lakeville,	16	5	11	–	14	–	2	16	–	–	12	4	–	16	–
Lancaster,	99	39	9	51	77	17	5	84	13	2	94	5	–	92	7
Lanesborough,	112	93	10	9	91	19	2	112	–	–	109	3	–	110	2
Lawrence,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lee,	185	120	18	47	149	31	5	147	38	–	113	72	–	167	18
Leicester,	83	19	55	9	71	8	4	76	7	–	79	4	–	76	7
Lenox,	51	17	5	29	38	13	–	44	7	–	39	12	–	47	4
Leominster,	67	8	58	1	28	39	–	56	11	–	61	6	–	37	30
Leverett,	103	50	47	6	66	30	7	100	3	–	101	2	–	89	14
Lexington,	60	–	56	4	52	8	–	55	5	–	55	5	–	51	9

Inspection of Barns, Stables, etc., in which Cattle are kept — Continued.

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Leyden, . . .	67	13	40	14	53	9	5	64	3	–	67	–	–	66	1
Lincoln, . . .	99	19	75	5	54	44	1	51	48	–	92	–	7	64	35
Littleton, . . .	90	3	83	4	86	4	–	86	4	–	81	8	1	88	2
Longmeadow, . .	53	38	11	4	42	2	9	44	1	8	51	2	–	53	–
Lowell, . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ludlow, . . .	129	74	48	7	77	40	12	93	29	7	119	10	–	104	25
Lunenburg, . .	132	27	103	2	97	20	15	125	7	–	120	10	2	125	7
Lynn, . . .	112	62	41	9	68	39	5	108	3	1	104	8	–	111	1
Lynnfield,. . .	30	7	23	–	29	1	–	30	–	–	30	–	–	28	2
Malden, . . .	12	10	1	1	5	7	–	7	5	–	12	–	–	10	2
Manchester, . .	29	2	23	4	28	1	–	29	–	–	29	–	–	29	–
Mansfield, . .	83	2	6	75	55	20	8	67	16	–	68	10	5	70	13
Marblehead, . .	56	29	25	2	51	5	–	54	2	–	52	4	–	54	2
Marion, . . .	29	9	20	–	20	8	1	28	1	–	22	7	–	24	5
Marlborough, . .	117	20	38	59	105	12	–	111	6	–	116	1	–	113	4
Marshfield, . .	138	58	71	9	71	60	7	131	3	4	125	13	–	129	9
Mashpee, . . .	17	3	14	–	12	5	–	16	1	–	17	–	–	17	–
Mattapoisett, . .	88	18	70	–	65	19	4	84	4	–	40	47	1	78	10
Maynard, . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Medfield, . . .	67	17	40	10	66	1	–	65	2	–	60	7	–	58	9
Medford, . . .	65	–	6	59	52	13	–	60	5	–	61	3	1	61	4
Medway, . . .	56	9	45	2	47	9	–	41	15	–	49	7	–	45	11

Melrose,	56	41	15	–	43	10	3	46	10	–	55	–	1	36	20
Mendon,	154	32	120	2	126	28	–	144	6	4	140	9	5	139	15
Merrimac,	61	28	27	6	39	22	–	51	9	1	55	6	–	58	3
Methuen,	132	12	118	2	110	20	2	88	23	21	130	2	–	120	12
Middleborough,	191	55	132	4	139	39	13	188	3	–	164	27	–	185	6
Middlefield,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Middleton,	43	–	–	43	39	4	–	41	2	–	31	12	–	37	6
Milford,	120	33	81	6	105	10	5	76	43	1	112	8	–	101	19
Millbury,	83	14	67	2	65	18	–	65	6	12	71	12	–	74	9
Millis,	55	3	46	6	46	4	5	55	–	–	49	5	1	53	2
Milton,	77	18	39	20	67	10	–	74	3	–	73	4	–	74	3
Monroe,	28	16	–	12	14	8	6	22	6	–	25	3	–	24	4
Monson,	154	65	82	7	104	50	–	137	16	1	150	4	–	146	8
Montague,	115	55	49	11	78	30	7	95	20	–	100	15	–	110	5
Monterey,	79	74	3	2	25	50	4	72	7	–	70	9	–	68	11
Montgomery,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mt. Washington,	23	1	19	3	15	8	–	22	1	–	20	3	–	23	–
Nahant,	11	7	4	–	7	4	–	9	2	–	11	–	–	8	3
Nantucket,	88	16	69	3	63	20	5	87	1	–	85	3	–	81	7
Natick,	63	12	41	10	51	12	–	51	12	–	59	4	–	50	13
Needham,	14	3	11	–	10	4	–	9	5	–	14	–	–	14	–
New Ashford,	21	20	1	–	21	–	–	21	–	–	19	2	–	21	–
New Bedford,	89	23	65	1	53	20	16	78	11	–	82	7	–	80	9
New Braintree,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
New Marlborough,	103	55	15	33	70	33	–	102	1	–	96	7	–	102	1
New Salem,	115	42	64	9	112	3	–	114	1	–	108	7	–	113	2
Newbury,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Newburyport,	33	14	16	3	32	1	–	31	2	–	30	–	3	32	1
Newton,	268	85	150	33	226	35	7	220	38	10	241	22	5	223	45
Norfolk,	69	48	20	1	64	4	1	68	1	–	50	17	2	67	2
North Adams,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

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North Andover, .	72	5	67	–	68	4	–	72	–	–	68	4	–	72	–
North Attleborough,	96	28	62	6	90	3	3	74	20	2	72	21	3	89	7
North Brookfield, .	162	50	101	11	128	34	–	158	4	–	143	19	–	155	7
North Reading, .	58	19	36	3	51	4	3	53	4	1	55	3	–	54	4
Northampton. . .	34	22	1	11	14	20	–	22	12	–	33	1	–	30	4
Northborough, . .	100	18	80	2	96	3	1	89	8	3	92	8	–	99	1
Northbridge, . .	50	18	30	2	42	8	–	49	1	–	42	8	–	47	3
Northfield, . .	119	87	30	2	96	20	3	112	3	4	106	13	–	113	6
Norton, . . .	141	48	86	7	115	16	10	141	–	–	137	2	2	140	1
Norwell, . . .	117	49	68	–	85	10	22	102	15	–	111	6	–	98	19
Norwood, . . .	33	9	22	2	27	5	1	32	1	–	33	–	–	31	2
Oakham, . . .	63	24	36	3	53	10	–	60	3	–	40	20	3	61	2
Orange, . . .	198	64	116	18	110	66	22	160	30	8	193	3	2	159	39
Orleans, . . .	47	37	1	9	47	–	–	44	3	–	25	22	–	46	1
Otis, ...	102	34	55	13	52	42	8	102	–	–	63	39	–	102	–
Oxford, . . .	49	8	40	1	41	6	2	47	2	–	44	5	–	48	1
Palmer, . . .	83	31	39	13	56	15	12	78	5	–	64	19	–	83	–
Paxton, . . .	54	20	30	4	29	23	2	47	5	2	48	6	–	47	7
Peabody, . . .	53	12	39	2	48	5	–	45	5	3	47	6	–	50	3
Pelham, . . .	74	45	18	11	40	8	26	68	1	5	57	16	1	64	10
Pembroke, . . .	96	31	61	4	90	6	–	91	5	–	92	4	–	92	4
Pepperell, . . .	174	34	133	7	136	31	7	169	5	–	161	9	4	109	65

Peru,	52	24	6	22	43	7	2	52	–	–	47	5	–	52	–
Petersham,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Phillipston,	70	32	38	–	61	9	–	52	10	8	50	10	10	59	11
Pittsfield,	62	47	3	12	36	20	6	37	23	2	43	17	2	45	17
Plainfield,	71	29	36	6	40	26	5	55	14	2	59	12	–	58	13
Plymouth,	136	60	69	7	110	20	6	129	5	2	131	5	–	128	8
Plympton,	58	28	25	5	34	16	8	48	9	1	49	9	–	53	5
Prescott,	67	34	32	1	31	28	8	62	5	–	57	10	–	60	7
Princeton,	69	13	52	4	50	19	–	69	–	–	63	6	–	63	6
Provincetown,	14	–	14	–	12	2	–	12	2	–	6	8	–	14	–
Quincy,	71	26	39	6	65	5	1	66	4	1	68	3	–	67	4
Randolph,	89	32	49	8	44	39	6	83	6	–	84	5	–	84	5
Raynham,	28	22	4	2	15	13	–	23	4	1	24	4	–	18	10
Reading,	53	25	25	3	51	2	–	53	–	–	50	3	–	53	–
Rehoboth,	250	83	156	11	248	1	1	245	5	–	236	14	–	247	3
Revere,	23	12	9	2	23	–	–	23	–	–	23	–	–	23	–
Richmond,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rochester,	73	27	46	–	40	24	9	–	73	–	42	31	–	71	2
Rockland,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rockport,	59	42	12	5	49	7	3	54	5	–	51	8	–	56	3
Rowe,	66	54	10	2	64	2	–	61	5	–	64	2	–	63	3
Rowley,	63	33	30	–	52	11	–	60	3	–	54	9	–	60	3
Royalston,	33	–	33	–	33	–	–	33	–	–	30	3	–	33	–
Russell,	34	24	6	4	18	16	–	34	–	–	30	4	–	33	1
Rutland,	158	33	120	5	146	12	–	153	3	2	150	8	–	154	4
Salem,	11	2	9	–	5	6	–	9	2	–	11	–	–	9	2
Salisbury,	35	16	16	3	23	9	3	21	11	3	27	8	–	28	7
Sandisfield,	118	92	5	21	103	12	3	111	7	–	112	6	–	115	3
Sandwich,	92	9	81	2	87	5	–	89	3	–	86	6	–	90	2
Saugus,	66	26	37	3	50	10	6	64	2	–	63	3	–	64	2
Savoy,	102	87	10	5	42	50	10	96	6	–	95	5	2	97	5

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Scituate,	146	45	94	7	81	38	27	110	33	30	124	14	8	120	26
Seekonk,	131	50	78	3	92	35	4	118	10	3	120	10	1	125	6
Sharon,	74	20	44	10	66	4	4	72	2	–	71	3	–	68	6
Sheffield,	230	19	191	20	110	60	60	206	24	–	216	9	5	215	15
Shelburne,	105	25	57	23	102	3	–	103	2	–	100	4	1	104	1
Sherborn,	95	18	65	12	81	14	–	89	4	2	80	9	6	92	3
Shirley,	65	15	49	1	57	3	5	53	10	2	60	4	1	51	14
Shrewsbury,	131	28	97	6	122	7	2	94	35	2	124	5	2	121	10
Shutesbury,	52	24	28	–	40	4	8	47	5	–	45	7	–	52	–
Somerset,	64	20	41	3	57	7	–	64	–	–	61	3	–	62	2
Somerville,	69	25	32	12	52	17	–	50	19	–	67	2	–	64	5
South Hadley,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Southampton,	147	25	116	6	95	45	7	145	2	–	140	5	2	145	2
Southborough,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Southbridge,	93	39	51	3	68	25	–	61	22	10	87	6	–	78	15
Southwick,	152	23	115	14	84	60	8	113	37	2	145	7	–	145	7
Spencer,	136	39	90	7	119	15	2	125	11	–	127	9	–	131	5
Springfield,	41	25	3	13	29	8	4	30	11	–	40	1	–	38	3
Sterling,	159	36	116	7	130	25	4	158	1	–	145	7	7	158	1
Stockbridge,	110	50	20	40	78	13	19	106	4	–	82	28	–	98	12
Stoneham,	46	16	26	4	31	12	3	36	7	3	41	5	–	38	8
Stoughton,	63	7	49	7	51	12	–	44	19	–	60	3	–	50	13

Stow, . . .	82	13	67	2	76	6	–	72	6	4	75	5	2	80	2
Sturbridge, . .	74	28	46	–	68	5	1	73	1	–	71	3	–	70	4
Sudbury, . . .	92	25	66	1	77	11	4	92	–	–	84	6	2	90	2
Sunderland, . .	97	58	36	3	78	17	2	94	3	–	91	5	1	95	2
Sutton, . . .	180	65	109	6	108	51	21	173	7	–	153	27	–	138	42
Swampscott, . .	26	12	11	3	25	1	–	23	3	–	22	4	–	23	3
Swanzey, . . .	117	48	68	1	92	21	4	104	10	3	102	12	3	111	6
Taunton, . . .	65	9	47	9	40	25	–	56	9	–	59	6	–	50	15
Templeton, . .	68	31	37	–	40	24	4	54	10	4	63	5	–	51	17
Tewksbury, . .	74	10	61	3	59	15	–	66	6	2	69	5	–	67	7
Tisbury, . . .	21	9	12	–	21	–	–	21	–	–	20	1	–	19	2
Tolland, . . .	56	41	11	4	25	25	6	48	8	–	53	3	–	52	4
Topsfield, . . .	64	24	40	–	42	18	4	56	6	2	49	15	–	58	6
Townsend, . .	135	38	92	5	115	19	1	117	18	–	105	30	–	116	19
Truro, . . .	75	49	12	14	66	7	2	73	2	–	70	5	–	73	2
Tyngsborough, .	36	10	23	3	32	2	2	34	2	–	36	–	–	32	4
Tyringham, . .	54	28	25	1	46	4	4	54	–	–	49	5	–	54	–
Upton, . . .	114	19	92	3	100	12	2	101	11	2	103	11	–	109	5
Uxbridge, . .	164	26	127	11	123	27	14	146	9	9	126	37	1	131	33
Wakefield, . .	74	25	46	3	70	4	–	68	6	–	72	2	–	74	–
Wales, . . .	65	27	33	5	38	18	9	63	2	–	39	25	1	65	–
Walpole, . . .	128	35	91	2	117	11	–	120	6	2	120	7	1	122	6
Waltham, . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ware, . . .	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Wareham, . .	97	46	50	1	64	20	13	76	17	4	53	40	4	84	13
Warren, . . .	154	55	79	20	67	78	9	97	57	–	153	1	–	118	36
Warwick, . . .	80	50	28	2	59	21	–	75	3	2	78	2	–	76	4
Washington, . .	71	30	33	8	65	5	1	69	2	–	65	6	–	67	4
Watertown, . .	15	10	4	1	10	4	1	13	2	–	15	–	–	15	–
Wayland, . . .	86	17	68	1	80	6	–	81	5	–	71	15	–	85	1
Webster, . . .	51	20	28	3	46	5	–	42	9	–	49	2	–	49	2

Inspection of Barns, Stables, etc., in which Cattle are kept — Concluded.

	Number of Stables inspected.	Number of Stables on the Ground.	Number of Stables over Cellars.	Number of Stables in Cellars.	Number of Stables with Good Light.	Number of Stables with Bad Light.	Number of Stables with no Light.	Number of Stables with Good Ventilation.	Number of Stables with Bad Ventilation.	Number of Stables with no Ventilation.	Number of Stables with Good Water Supply.	Number of Stables with Fair Water Supply.	Number of Stables with Bad Water Supply.	Number of Stables kept Clean.	Number of Stables kept Unclean.
Wellesley,	11	1	10	-	8	3	-	7	4	-	11	-	-	10	1
Wellfleet,	48	31	4	13	37	7	4	44	4	-	26	11	11	46	2
Wendell,	62	31	29	2	59	1	2	62	-	-	58	4	-	61	1
Wenham,	44	8	35	1	32	12	-	35	9	-	41	3	-	42	2
West Boylston,	76	8	68	-	69	6	1	76	-	-	57	18	1	67	9
West Bridgewater,	48	9	33	6	31	17	-	41	7	-	48	-	-	46	2
West Brookfield,	96	41	51	4	81	15	-	75	17	4	75	15	6	84	12
West Newbury,	21	10	11	-	20	1	-	21	-	-	12	8	1	21	-
West Springfield,	119	75	21	23	116	3	-	117	2	-	96	23	-	119	-
West Stockbridge,	131	95	2	34	105	25	1	130	1	-	59	72	-	131	-
West Tisbury,	61	37	23	1	61	-	-	61	-	-	48	13	-	61	-
Westborough,	9	-	9	-	6	3	-	9	-	-	9	-	-	9	-
Westfield,	236	185	19	32	112	56	68	142	93	1	234	2	-	188	48
Westford,	129	31	98	-	106	23	-	126	3	-	86	43	-	109	20
Westhampton,	86	32	39	15	62	24	-	63	23	-	72	10	4	74	12
Westminster,	97	43	49	5	66	31	-	88	9	-	78	17	2	96	1
Weston,	140	21	102	17	128	12	-	113	25	2	130	6	4	123	17
Westport,	320	98	211	11	225	89	6	299	16	5	306	12	2	309	11
Westwood,	54	9	43	2	42	12	-	51	3	-	50	4	-	51	3
Weymouth,	209	113	72	24	157	49	3	186	21	2	179	28	2	192	17
Whately,	112	86	15	11	78	34	-	110	2	-	92	13	7	106	6
Whitman,	82	28	45	9	50	30	2	61	20	1	78	4	-	63	19

Wilbraham,	165	61	94	10	120	41	4	161	4	–	151	9	5	150	15
Williamsburg,	92	46	31	15	72	17	3	69	15	8	80	12	–	77	15
Williamstown,	191	134	30	27	159	30	2	188	3	–	180	11	–	183	8
Wilmington,	99	42	54	3	86	13	–	95	4	–	96	3	–	96	3
Winchendon,	168	97	62	9	143	24	1	152	16	–	149	17	2	149	19
Winchester,	18	6	8	4	12	4	2	14	3	1	13	5	–	14	4
Windsor,	111	68	10	33	70	20	21	100	6	5	88	23	–	108	3
Winthrop,	25	–	–	25	22	3	–	24	1	–	25	–	–	25	–
Woburn,	90	–	90	–	78	12	–	77	13	–	86	4	–	90	–
Worcester,	315	47	224	44	129	183	3	132	183	–	296	16	3	160	155
Worthington,	124	61	27	36	109	8	7	119	5	–	110	14	–	121	3
Wrentham,	143	32	109	2	57	76	10	100	40	3	120	23	–	70	73
Yarmouth,	77	38	22	17	33	38	6	74	3	–	64	13	–	75	2
Totals,	30,013	10,685	15,211	4,117	21,968	6,345	1,700	26,541	3,064	408	26,231	3,269	513	27,077	2,936

Summary of Above Inspection.

Number of stables inspected,	30,013
Number of stables on the ground,	10,685
Number of stables over cellars,	15,211
Number of stables in cellars,	4,117
Number of stables with good light,	21,968
Number of stables with bad light,	6,345
Number of stables with no light,	1,700
Number of stables with good ventilation,	26,541
Number of stables with bad ventilation,	3,064
Number of stables with no ventilation,	408
Number of stables with good water supply,	26,231
Number of stables with fair water supply,	3,269
Number of stables with bad water supply,	513
Number of stables kept clean,	27,077
Number of stables kept unclean,	2,936

The inspections of previous years have certainly had a beneficial result, as reports come from inspectors all over the State that they find the condition of the neat stock much more satisfactory than in previous years, and they are unanimous in stating that it is, in their opinion, the result of the examinations made in former years. A few sample letters will serve to illustrate this feeling: —

Bridgewater, Mass., Dec. 4, 1899.

To the Honorable Board of Cattle Commissioners.

I have the pleasure of reporting, as inspector of animals for the town of Bridgewater, that, after viewing 128 premises, I have seen 601 animals and found only 1 to quarantine. I have 2 under observation, and they are single, — that is, not with others; I may quarantine them later. There are also over 100 head at the State Farm in a wooden stable. No stock except that raised on the farm has been added since the Board examined the whole stock.

Although I have said in many cases, in answer to the question "No improvements," the general tone of care for and interest in stock which has been tested is on the increase in our town, and the marked improvement in stock and care for same is much better. The moral effect of a cattle inspector I find is good, and

lasting from year to year. I think that my town and district will make a good showing as to freedom from tuberculosis or other contagious disease.

Respectfully, CALVIN PRATT,
Inspector.

PEPPERELL, MASS., NOV. 18, 1899.

Dr. AUSTIN PETERS, *Chairman of the Cattle Commission.*

DEAR SIR: — I send you in another cover my report of the inspection for this year, and wish to say I never saw the cattle in this town looking so well and in so healthy a condition as they are now. There has been a steady improvement in the condition of the stables, as well as the health of the animals, each year since the inspection began. The farmers and cattle owners are trying to carry out the rules and regulations laid down by your Board.

The first year of the inspection, when the State paid only for such animals as were killed and found healthy, there were 46 put in quarantine, and all of them were condemned and killed by the Cattle Commission, and all were found diseased but 1, for which the State paid $12. This year, after six or seven years' experience, only 4 suspicious cattle were quarantined. One of them was released on physical examination, 1 was released on the tuberculin test, and 2 were killed and found diseased and were paid for by the State at $10 and $18. We think there has been a great improvement in six years.

Yours respectfully, S. P. BANCROFT.

NORTH BROOKFIELD, MASS., NOV. 14, 1899.

To the Honorable State Board of Cattle Commissioners.

DEAR SIRS: — I have this day finished the general inspection of cattle, sheep and swine in my territory. I have quarantined only 4 cows out of over 800 cattle. I find considerable improvement in the cleanliness of the barns and stables and the facility for watering stock, and the water given is much improved since my last inspection.

I send you this day the returns of inspection, hoping my work for the last four years may meet with your approval.

I am your obedient servant, B. F. BARNES,
Inspector.

SUNDERLAND, MASS., NOV. 16, 1899.

State Board of Cattle Commissioners.

GENTLEMEN: — I enclose the final reports of inspections of animals and barns. I have found no more cases of animals that could be condemned as tuberculous on physical examination.

The present condition of live stock shows good results of work done in previous years. Hope the next appropriation will be sufficient to test and dispose of suspicious cases.

Yours very truly, GEO. P. SMITH,
Inspector.

The cleaning up of herds has been done to a very limited extent, and only under the following conditions: the State furnishes tuberculin and an agent to test the cattle, and pays for reacting animals that are unfit for food, on condition that the owner will take the beef value from the butcher for those that are fit for food, and will thoroughly disinfect his premises at his own expense under rules laid down by the Board, and will buy only healthy cattle to take the place of the diseased ones. These requirements bring part of the burden on the owner, and, if he is not sincere in his desire to eradicate tuberculosis from his herd and willing to co-operate with the Cattle Commission, he will not agree to them. It is useless to attempt to eradicate tuberculosis from a herd without the co-operation of the owner, and it is better to wait until the farmer is ready to come to the commission and ask its assistance than to force its services upon him.

Herds have been tested in the following places and results obtained as below: —

DATE.	Name.	Town.	No. tested.	No. released.	No. condemned and paid for.	Disposed of by Owner.
June 27,	S. C., ...	Westwood, .	22	22	–	–
Dec. 20,	S. C., second test, .	Westwood, .	40	38	2*	–
Aug. 24,	F. L. W., . . .	Dalton, .	14	6	4	2
Oct. 27,	F. L. W., second test,	Dalton, .	15	13	2†	–
Oct. 23,	P. W. M., . . .	Shrewsbury,	45	39	4	2
Nov. 6,	P. W. M., . . .	Shrewsbury,	11	2	5	4
Nov. 24,	Institution, . . .	Waltham, .	28	23	2	3
Nov. 24,	C. W. S., . . .	Leyden, .	20	6	12	2
Dec. 15,	G. H. E., . . .	Weston, .	63	62	–	1
Dec. 20,	G. H. E., . . .	Concord, .	102	101	–	1
Dec. 26,	G. H. E., . . .	Newton, .	154	151‡	–	3
Dec. 15,	W. H. R., . . .	Montague, .	29	8	21	–
Dec. 28,	L. L. F., . . .	Greenfield, .	11	6	5	–
Sept. 25,	D. Brothers, . .	Amherst, .	11	3	6	2
			565	480	63	20

* These two animals were new acquisitions to the herd after June 27.

† These two reacted the first test, but were not killed until retested, October 27.

‡ Three to be retested.

A word of explanation is necessary in regard to the herds of S. C. and G. H. E.

G. H. E. has been trying to eradicate tuberculosis from his herd for some time, and in the past he has had the assistance of the commission. In 1898, the appropriation being insufficient, he tested his cattle at his own expense, and killed those that reacted to the tuberculin test. Of the 5 animals in his three herds which reacted this winter, only 2 were in the old herd, 1 at Weston and 1 at Concord. The 3 in the herd at Newton which reacted were animals which he had recently bought on certificates of tuberculin test at Brighton of dealers; it is a question whether these cows were honestly tested before he bought them, or not.

S. C. tested his herd at his own expense in December, 1898, and killed 7 animals. The commission tested the herd for him in June, after receiving the appropriation, and found no reacting animals; it again tested the herd for him Dec. 20, 1899, and but 2 animals reacted. These were cows which he had taken to board for the winter, which had been tested with tuberculin, but some time ago, and had probably acquired the disease after being tested and before S. C. introduced them into his herd.

Prior to May 25 the commission received the slaughter house returns from the inspectors of animals; but the act passed at that time placed this work in the charge of the local boards of health, and since then they have been expected to take care of the inspection of slaughter houses and of animals killed for food at the time of slaughter.

Inspected at Licensed Slaughter Houses at Time of Slaughter, for Six Months ending May 31, 1899.

Cattle (including calves),	39,254	
Sheep,	122,581	
Swine,	737,049	
Total,		898,884

Inspected at Time of Slaughter, under Section 21, Chapter 491, Acts of 1894, for Six Months ending May 31, 1899.

Cattle (including calves),	695	
Sheep,	24	
Swine,	2,122	
Total,		2,841
Total reported inspections at time of slaughter,		901,725

Animals destroyed as Tuberculous.

Cattle,	89
Sheep,	–
Swine,	30
Number of towns reporting licensed slaughter houses,	71
Number of licensed slaughter houses reported,	172

In addition to the cases of tuberculosis that the commission has dealt with in the regular way, 50 cases have been reported by different persons since the inspection of slaughtered animals was placed in the charge of the boards of health. These have been found in the slaughter houses, or have been killed with the owners' consent (they waiving their right to compensation from the State), or have been reported by renderers.

Bovine tuberculosis requires to be looked upon from two different stand-points: one, the possible danger to human life and health from the use of the flesh and dairy products of animals with a disease analogous to, if not identical with, tuberculosis in mankind; the other, as a troublesome, infectious disease of cattle, causing large annual losses to our farmers and breeders by the deaths or diminution in value of the neat stock, as well as the shrinkage in their products, making them a less source of profit to their owners than healthy cattle.

The problem of the management of bovine tuberculosis is attracting the attention of all civilized nationalities at the present time, especially in those localities where cattle are kept in a state of close cohabitation, for the purpose of utilizing their dairy products by the sale of milk or the manufacture of butter and cheese. The question is not of such vital importance in beef-producing communities, where the cattle are less closely confined and range over large areas of territory, as here it is not propagated so readily or rapidly, and hence is a source of less danger and loss; that is, the close confinement and sanitary (or rather unsanitary) surroundings under which dairy cattle and young animals being bred for the dairy are kept renders them peculiarly susceptible to the ravages of this scourge; in addition to this, lactation is a constant source of depletion to vitality in the milch cow.

At the Seventh International Congress of Veterinary Sur-

geons, held in Baden-Baden, Aug. 7 to 12, 1899, to which the chairman of this Board was a delegate, although he was unable to attend, and at which Dr. Frothingham, who does the bacteriological work of this Board, was present, a number of papers were presented by the leading veterinary officials of many of the European countries upon the control of bovine tuberculosis. All are agreed upon the importance of the work and the necessity of taking measures for the suppression of this disease, because of its possible danger to the public health, as well as on account of the losses it imposes upon cattle owners. It is also generally conceded that, because of its infectious character and widespread prevalence, it is a matter of veterinary, sanitary police, that should be taken charge of by the State just as much as glanders, rabies or contagious pleuro-pneumonia. Among those presenting reports upon the prevention of tuberculosis among domestic animals were Prof. B. Bang, of the Veterinary School of Copenhagen, representing Denmark; Dr. O. Malm, director of the Civil Veterinary Department, Norway; Mr. G. Regner, military veterinary surgeon, attached to the Board of Agriculture, Stockholm, Sweden; Dr. R. Rudovsky, State veterinarian at Brunn, Austria; Dr. Siedamgrotsky, chief veterinary officer in Saxony; and Dr. L. Stubbe of Brussels, veterinary inspector of the Board of Agriculture in Belgium.

The prevalence of tuberculosis varies in different localities. In Austria, Rudovsky thinks that only between 1 and 2 per cent. of the cattle are diseased; in Sweden, Regner thinks 20 per cent. may be infected; and in Norway, Malm gives it as his opinion that it exists on 25 per cent. of the farms, and that between 8 and 9 per cent. of all the cattle are infected.

In eastern Massachusetts, judging from the experience of this commission with veterinarians making private tests for owners in the spring of 1897, it is not unfair to assume that a condition of affairs exists quite as bad as in the more populous dairy districts of northern Europe. While less has been done towards State control of tuberculosis in England and Germany than in France and some of the smaller European countries, like Sweden, Norway, Denmark and Belgium, it is not because the importance of the trouble is not realized, but because the best means for undertaking the

eradication of bovine tuberculosis is being deliberated upon. England has had a Royal Commission on Tuberculosis investigating this malady for several years, whose work has been alluded to in a previous report of this Board.

At the conclusion of the International Congress in Baden-Baden, last August, the following resolutions were adopted : —

The Prevention of Tuberculosis amongst Domestic Animals.

1. The prevention of tuberculosis in cattle is urgently needed.

2. The extinction of bovine tuberculosis on the part of the owners (voluntary extinction) is practicable, and should be universally aimed at. It demands the slaughter of dangerous tuberculous beasts as soon as possible, as well as careful protection of calves and healthy animals from infection. The voluntary extinction of bovine tuberculosis should be encouraged by the State, through the dissemination of correct views respecting the character of tuberculosis, respecting the modes of infection and the importance of tuberculin inoculation, and be supported by State grants. The best means hitherto known for the prevention of tuberculosis among domestic animals is tuberculin. Tuberculin should only be supplied under State control. In any case it should be given to veterinary surgeons alone.

3. A State prevention of bovine tuberculosis is thoroughly to be recommended. If it is applied with a certain caution, it can be carried out, and will hinder the further increase of the disease and will gradually stop it. The prevention requires : —

(*a*) The obligation of the veterinary surgeon to give the legal notice of every case of proved tuberculosis in the exercise of his practice.

(*b*) The quickest possible slaughter of dangerously tuberculous animals (particularly those animals which are affected with mammitis, tuberculosis of the uterus and of the intestines, as well as pulmonary tuberculosis), compensation being granted by the State, and the prohibition of the return of buttermilk from the co-operative dairies until it has been sterilized.

The Use of the Flesh and Milk of Tuberculous Animals.

A. Of the Flesh.

Granted that a general compulsory inspection of slaughter animals exists before and after slaughter, the following measures are to be prescribed, in view of dangers for the health of the people which may be connected with the consumption of the flesh of tuberculous animals : —

1. Those professional men who carry out meat inspection are expected to examine the slaughtered animals, and so to give a guarantee that every case of tuberculosis among the slaughtered animals — and in every such case the spread of the tuberculous process — will be accounted for with certainty.

2. The most important part of the meat inspection is the sure detection and the perfectly uninjurious removal of the organs that have been changed by tuberculosis, together with their appendages.

3. With regard to the flesh of tuberculous animals, the parts affected with tuberculous centres and bound by the corresponding lymphatic glands are to be treated in the same way as the tuberculously altered organs. If the tuberculous alterations in the meat are confined to the lymphatic glands situated in it, the muscle may, after cutting out the bones, joints, vessels and lymphatic glands and adequate dissection, be handed over, in a sterilized condition, to be used for food. In the case of fat animals, the melting out of the fat tissue that has been separated, with avoidance of the tuberculous centres, is likewise permitted.

4. In the case of local tuberculosis and in that of general tuberculosis healed and limited to the organs of the cavities, the meat may be dealt out raw, to be used as food. If the tuberculous process in the intestines is of considerable extent, the obligation to declare it is to be insisted upon.

5. The whole of the meat, except the melted fat, is to be withdrawn from use as human food, if there exist marked emaciation or the signs of very recent infection of the blood (tumor in the spleen, and swelling of the lungs, liver, spleen or kidneys).

6. In cases where the local character of tuberculosis and the harmlessness of the meat are doubtful (especially when there are tuberculous caverns and incipient derangement of nutrition), the whole of the meat is to be sterilized before being handed over as fit for food.

7. The sterilized meat and the melted fat is to be sold under declaration.

B. Of the Milk.

1. The cows, goats, etc., kept for dairy purposes are to be subjected to regular veterinary control.

2. The milk of tuberculous animals is not to be used for human food, if the animals are emaciated or affected with tubercles in the mammæ.

3. In accordance with the mode of proceeding in the kingdoms of Denmark and Sweden, the emaciated and tuberculous dairy animals are to be immediately removed from the farms and destined for slaughter, compensation being given to owners.

It will be seen by these resolutions that a system of veterinary sanitary police contemplates an efficient inspection of slaughter houses. This, however, applies more to the protection of the public health than to the eradication of disease.

The laws under which this commission acted prior to May 25, 1899, provided that it should receive the returns of inspections of slaughtered animals from the inspectors of animals and provisions in the different cities and towns, and also that it furnish applications for licenses for slaughter houses, and that a duplicate of every license granted in the State should be on file at the office of the Board of Cattle Commissioners. This did not seem to have much to do with the eradication of disease, and the inspection was placed in the hands of the local boards of health by section 20, chapter 408, Acts of 1899, as it seemed to be more of a local sanitary matter than one closely connected with the control of bovine tuberculosis, and it caused a good deal of extra work in the office of the commission, without any corresponding benefit. What the slaughter-house inspection by the local boards of health amounts to is a matter of conjecture. Every week old, emaciated cows, called "canners" and "bologna cows," are shipped to our markets for "beef," not only from without the limits of the Commonwealth but from towns in the dairy districts of the State. Many of these must be diseased and unfit for human food; yet, if the slaughter-house inspection was properly carried out, this contemptible business would not be as profitable as it appears to be, and would be given up. If the Cattle Commission seized the animals which were clearly diseased coming from without the limits of the State, they could be killed without appraisal or payment, and rendered as they ought to be; yet, if this were done, it would be unfair unless similar animals coming from within the limits of Massachusetts were also seized and killed. Such animals would, however, have to be paid for, if they had been owned within the State for six months prior to condemnation, from the appropriation of the commission.

As the object of the law is to kill diseased animals whose milk may be unhealthful or which may be a source of contamination to other cattle, it seems proper to allow them to

proceed to the slaughter house, if the inspection there is properly made. Theoretically, the health of the people is protected; practically, it is a question if the inspection is anything more or less than a farce in many places.

There is also a section in the law relative to meat inspection requiring all calves killed for veal to be over four weeks old; yet, as a matter of fact, half the calves killed for food are not more than one to two weeks old; a number are only a few days old, and some are no better than living abortions. If veal from calves under four weeks old is unhealthful, the law should be enforced; if it is proper that human beings should eat meat from any kind of a calf, the law should be repealed. If the law as it stands is too strict, it should be modified to meet the requirements of civilization, and then it should be uniformly enforced everywhere.

At some abattoirs there is an inspector of the United States Bureau of Animal Industry to examine beef and pork for export to foreign countries; he will not pass anything that the sanitary laws of those countries consider as unfit for food for their peoples, yet in some places what he will not pass as fit for food is sold to our own citizens. Surely the people of this country ought to be entitled to the same protection from the State that the United States government guarantees to foreigners.

The present policy of the Massachusetts Board of Cattle Commissioners follows the plan laid down in the resolutions given above, outside of the matter of slaughter-house inspection. The methods formerly pursued by the State have been found too extravagant and expensive. Similar measures were tried in Belgium, and proved there to be too costly.

During the past year cows that showed marked physical evidence of tuberculosis were condemned and killed; a few have been passed as fit for beef, but most of them were only fit to be rendered. When cows can be condemned on a physical examination, the work can be done at a less cost than under the former system, when the agent tested cows with tuberculin, and then reported the results to the office and received instructions which to kill and which to release. Under the present system, the agent examines, appraises and kills a diseased cow all at one visit. This system seems

to work satisfactorily, and very few complaints have arisen under it. Cows with nodulated udders have been tested with tuberculin, as have also some doubtful cases; if they reacted, they were destroyed.

Reducing the limit of value from $60 to $40 has resulted in a saving to the State. The appraisals have been very evenly made, and the average value, $22.50 per head, is much lower than it formerly was. The work of the local inspectors seems to be sufficient to protect the people from the milk of cows owned in Massachusetts which are sufficiently diseased to be a danger to the public health, besides which, the badly diseased cows are the greater sources of danger to others.

A few herds have been tested with tuberculin and reacting animals removed, but only where the owner has shown a disposition to co-operate with the commission.

The reports of the inspectors show that the inspections of previous years have resulted in a healthier condition of the cattle, and it seems as though the work previously done by them had resulted in a diminution of the disease; it certainly has, as far as the bad cases go; whether a tuberculin test would show a corresponding improvement is uncertain.

Many other States now require cattle brought into their limits to be kept for dairy or breeding purposes to be tested with tuberculin. Among those in New England are Maine, New Hampshire, Vermont and Rhode Island; while, outside of New England, New Jersey, Pennsylvania and Illinois require it, and others will undoubtedly adopt similar requirements in time. The United States government also requires that all cattle imported shall be tested with tuberculin at the port of entry, as well as holding them in quarantine there for ninety days; therefore it seems only proper that Massachusetts should maintain similar rules and regulations for the protection of her owners of live stock; yet this Board has been hampered and impeded and imposed upon in every possible way by avaricious cattle traders and dishonest veterinarians, who disgrace what ought to be an honorable profession by making out imaginary certificates of test upon animals that never had a drop of tuberculin under their

skins. This is one of the most perplexing problems confronting the Board at the present time.

The efforts of the Cattle Commission to eradicate bovine tuberculosis should be confined to an expense not greatly exceeding the cost of an inspection each year, — that is, practically an examination of dairy herds to protect the public health, — and the cost of keeping up the quarantine work against importing any diseased cattle. It should consist of: —

(*a*) A quarantine against diseased cattle from adjoining States, to insure a healthy supply to take the places of those killed by the State or disposed of in other ways, remembering that our bovine population changes every ten or twelve years, and in milkmen's herds much more rapidly, — say every four or five years.

(*b*) An annual inspection by the local inspectors of animals, to protect the public health and improve the sanitary surroundings of the cattle. These badly diseased creatures are of more danger to other cattle than slightly infected ones, and when removed their stalls should be thoroughly disinfected before replacing them with new purchases.

(*c*) If any money remains from the annual inspection, it should be expended in testing entire herds for owners who will agree to accept the conditions laid down by the Board. It is useless to endeavor to free a farmer's herd from tuberculosis unless he will promise to co-operate with the commission. After a farmer's herd is thoroughly freed from tuberculosis, he should receive no more assistance from the State, but be himself compelled to maintain it in a healthy condition. It is better for the present that the farmer shall apply to the commission of his own volition for assistance than that the commission should urge its attentions upon him.

Another important point for the protection of herds from tuberculosis on farms where the calves are raised is noted in the resolutions already quoted, and that is, the danger from skim-milk and buttermilk from creameries. In creameries, where the milk of a number of dairies is mixed, it is possible to infect the calves on farms where tuberculosis does not exist by taking home skim-milk or buttermilk to feed them, some of which comes from herds infected with tuberculosis.

It is recommended that all such food shall be sterilized before being fed to the calves.

In Europe, the sediment from the centrifugal separator is considered especially dangerous, and it is advised, and in some places required, that all such material shall be burned.

Working upon these lines, the Board of Cattle Commissioners is of the opinion that tuberculosis among cattle can in time be very materially diminished, at a cost to the State not greatly exceeding the expense of a thorough annual inspection of the herds, including taking out and paying for the bad cases, with the added cost of keeping up a quarantine against diseased cattle from other States; and believes with Bang, who says, "In some twenty years it will be possible to go further and take more severe measures."

Glanders.

During the past year glanders and farcy have prevailed to an extent that must be considered serious, if not even alarming. More cases or suspected cases of this dangerous disease have been reported to the Cattle Commission than during any year in its history, and this calls for the co-operation of every lover of the horse and every veterinarian in the State in the efforts of the Board to eradicate this loathsome malady.

From Dec. 15, 1898, to Dec. 15, 1899, 614 cases of suspected cases of glanders or farcy have been reported to the commission; and of these, 543 have been destroyed as being infected, and 71 have been released after a careful examination, and in some cases have been continued in quarantine for some little time for further observation, if they showed suspicious symptoms, and not allowed to go free until it was certain they were not infected.

The following shows the cities and towns from which cases were reported and the number in each: —

Towns.	Killed.	Released.	Totals.	Towns.	Killed.	Released.	Totals.
Acton, ...	–	1	1	Ashburnham, .	1	2	3
Andover, . .	1	–	1	Auburn, . .	1	–	1
Arlington, . .	8	2	10	Barre, . . .	–	1	1

Towns.	Killed.	Released.	Totals.
Berlin, . . .	2	–	2
Beverly, . .	1	–	1
Billerica, . .	1	–	1
Blandford, . .	–	1	1
Boston. . . .	159	2	161
Boxborough, .	1	–	1
Boylston, . .	1	–	1
Braintree, . .	2	–	2
Brockton, . .	6	2	8
Brookline, . .	3	–	3
Burlington, . .	1	–	1
Cambridge, . .	38	3	41
Charlton, . .	–	1	1
Chelsea, . .	12	–	12
Chicopee, . .	1	1	2
Clinton, . .	10	1	11
Danvers, . .	1	–	1
Dartmouth, . .	2	–	2
Dudley, . . .	1	–	1
Easton, . . .	–	1	1
Everett, . . .	4	–	4
Fall River, . .	10	1	11
Fitchburg, . .	9	3	12
Foxborough, .	–	1	1
Gardner, . .	2	–	2
Gloucester, . .	1	–	1
Granby, . .	–	1	1
Granville, . .	1	–	1
Great Barrington, .	1	–	1
Haverhill, . .	3	–	3
Hingham, . .	2	2	4
Holyoke, . .	–	1	1
Hopedale, . .	1	–	1
Hull, . . .	1	–	1
Ipswich, . .	–	2	2
Lawrence, . .	2	–	2
Leominster, . .	2	1	3
Lexington, . .	7	–	7
Lincoln, . .	1	–	1
Lowell, . . .	3	1	4
Lunenburg, . .	2	–	2
Lynn, . . .	22	6	28
Lynnfield, . .	1	–	1
Malden, . .	4	–	4
Marlborough, .	1	–	1
Medford, . .	1	–	1
Melrose, . .	6	–	6
Middleborough, .	3	–	3
Milford, . .	–	1	1
Millbury, . .	1	1	2
Milton, . . .	1	–	1
Nahant, . . .	3	–	3
Natick, . . .	1	–	1
Needham, . .	1	–	1
New Bedford, .	6	–	6
New Marlborough,	1	–	1
Newton, . .	13	1	14
North Andover, .	1	–	1
North Brookfield, .	–	1	1
Northborough, .	–	1	1
Norwood, . .	–	1	1
Palmer, . . .	1	–	1
Peabody, . .	1	1	2
Pittsfield, . .	1	–	1
Provincetown, .	–	1	1
Quincy, . .	3	2	5
Randolph, . .	1	–	1
Reading, . .	3	–	3
Revere, . . .	2	–	2
Rochester, . .	1	–	1
Saugus, . .	3	–	3
Somerville, . .	33	1	34
Springfield, . .	14	–	14
Sterling, . .	1	–	1
Stoneham, . .	2	1	3
Sudbury, . .	–	1	1
Swampscott, . .	1	–	1
Swansea, . .	2	–	2
Taunton, . .	2	–	2
Tyngsborough, .	1	–	1
Upton, . . .	1	–	1
Wakefield, . .	1	–	1
Waltham, . .	13	4	17
Watertown, . .	11	–	11
Wellesley, . .	15	3	18
West Boylston, .	1	–	1
Westminster, .	1	1	2
Weston, . .	1	–	1
Westwood, . .	1	–	1
Whitman, . .	1	–	1
Winchester, . .	1	–	1
Winthrop, . .	4	1	5
Woburn, . .	2	–	2
Worcester, . .	46	12	58
Wrentham, . .	1	–	1
	543	71	614

Of these 614 cases, 238 have called for the personal investigation of a member of the Board or one of its agents, with the following results: —

One hundred and thirty-nine were evident cases of disease, and were ordered killed.

Forty-eight were clearly free from disease, and were ordered released.

Fifty-two were doubtful cases, from which guinea pigs were inoculated.

In 27 instances the guinea pigs developed glanders, and the horses were destroyed.

In 25 cases the guinea pigs did not develop glanders. Of these, 21 horses were released and 4 were killed, having developed such marked clinical evidences of glanders while awaiting the results of the guinea-pig test as to render another test unnecessary. In one instance it was necessary to inoculate guinea pigs three times from the nasal discharge of a horse suspected of having glanders and farcy before they developed the disease, there not being enough germs of glanders present in the material taken the first and second times to infect these little animals; yet the horse was so suspicious that the Board did not feel that it ought to be released on the negative tests. The final results proved the suspicion to be well founded. In one or two other cases a second inoculation was necessary, but generally the test is decisive on a single trial.

Two horses were killed on a mallein test, and 1 released.

One case given as negative was not reported to the Board until the owner had disposed of it, and there is no positive proof that it had glanders; on the doubt, it is entered as negative.

A case reported as positive from Great Barrington is doubtful; the horse died in quarantine, and there was not a careful autopsy made upon it.

The 375 remaining cases mentioned were killed with the owners' consent, except 159 reported from the city of Boston, where the board of health had full charge of glanders, and 3 or 4 that died in quarantine, leaving 116 killed with the owners' consent outside of the city, except the few which died of the disease. Many of these were killed upon the advice of veterinarians, and in a great number of cases were reported to the Board as killed with the consent of the owner.

The above list of towns, being alphabetical, gives no idea of the geographical distribution of glanders and farcy in Massachusetts, but it can readily be seen that there are certain centres of infection; Boston is the principal one, here and in the surrounding cities and towns the larger number of cases are found; Worcester must be looked upon as another centre, from which occasional cases are taken to the neighboring towns; Fitchburg is another, although a smaller centre, the cases in Sterling, Leominster, Lunenburg, Ashburnham, Westminster and Gardner being more or less traceable to that city; Springfield is another small centre, and there are a few cases met with in the south-eastern corner of the State, in Fall River and New Bedford, and some of the intervening country towns. Occasionally cases occur in the cities of the Merrimac valley. Local outbreaks are also met with; for example, the cases occurring in Clinton seem to be the result of an outbreak there in 1898, 12 having been killed there in that year and 10 in 1899.

The cases reported from Newton and Wellesley represent another local outbreak, nearly all of these horses having been owned at Newton Lower Falls, on either side of the Charles River. At this point there are two public watering troughs, one in Newton and one on the Wellesley side of the line, which no doubt contributed to the spread of the disease in this village.

In order to obtain as complete returns of the number of cases of glanders and farcy occurring in this Commonwealth as possible, July 28 the following letter was sent to the principal renderers: —

BOSTON, July 1, 1899.

DEAR SIRS: — Your attention is called to the following sections of chapter 408 of the Acts of 1899: —

SECTION 14. Whenever in any city or town the board of health or any member or agent thereof, or any other person, except the members of the board of cattle commissioners, who has knowledge of or has good reason to suspect the existence of any contagious disease among any species of domestic animals within the limits of this Commonwealth, or that any domestic animal is affected with any such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give written notice thereof to the board of cattle commissioners or any of its members, agents or inspectors, and for

failure so to do shall be punished by a fine not exceeding one hundred dollars: *provided, however*, that no such notice shall be given in the city of Boston relating to the diseases known as glanders, farcy and rabies, which diseases shall be cared for by the board of health of the city of Boston.

SECTION 34. Every person who kills or causes to be killed, with the consent of the owner or person in possession thereof, any animal under suspicion that the same is affected with or has been exposed to a contagious disease, and who, upon the inspection of the carcass thereof, finds or is of the opinion that the same is affected with a contagious disease, shall notify such owner or person in possession thereof of the existence of such disease, and shall also immediately notify the board of cattle commissioners, its agent or inspector, of the same, and of the place where the animal was found, the name of the owner or owners, or person or persons in possession thereof, and of the disposal made of such carcass. Any person violating the provisions of this section shall be subject to the same penalties as are provided in section twenty-eight of this act.

SECTION 35. Contagious diseases under the provisions of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis.

This applies to renderers as well as to other persons. You will, therefore, in the future report all such cases to this Board.

Renderers within the limits of the city of Boston do not have to report cases of glanders, farcy or rabies to this Board, but to the Boston board of health, if said cases are found within the city limits; but all cases of glanders and farcy brought from without the limits of the city of Boston to such rendering establishments must be reported to the Board of Cattle Commissioners, together with the names and addresses of the owners.

Per order Massachusetts Cattle Commission,

AUSTIN PETERS,
Chairman.

The rendering establishments to which letters were sent, together with blanks for answers and stamped envelopes, were these: —

N. Ward Company, ...	South Boston.
Brighton Abattoir, . . .	Brighton.
Parmenter & Polsey, ...	Peabody.
Muller Brothers, ...	North Cambridge.
Swift Rendering Company, . . .	Lowell.
Lowe Brothers, ...	Fitchburg.
Bartlett's Rendering Works, . .	Worcester.

E. H. Gammon,	New Bedford.
Thos. Kirby,	South Hadley Falls.
W. H. Abbott,	Holyoke.
Bartlett & Holmes,	Springfield.
E. J. Whitman,	Dracut.
Wm. Lanery,	Amesbury.
W. C. Lawrence,	Brockton.
James E. McGovern,	Lawrence.

In this way the Board has received reports from the following renderers, since August 1, of cases of glanders and farcy: —

N. Ward Company,	14 reports, 53 cases.
Brighton Abattoir,	18 reports, 60 cases.
Muller Brothers,	14 reports, 32 cases.
Parmenter & Polsey,	3 reports, 3 cases.
J. E. McGovern,	4 reports, 3 cases.
Lowell Rendering Company,	2 reports, 1 case.
Lowe Brothers,	5 reports, 6 cases.
Bartlett & Holmes,	4 reports, 10 cases.

Where the reports exceed the number of cases of glanders, it is because tuberculosis was included in them.

The total number of reports thus received is 64 since August 1, and includes 168 horses. Thirty-four, or about 20 per cent. of these cases, were not reported through any other channel, and would not have come to the knowledge of the Board if it had not been for the renderers' reports. This shows that four cases of glanders or farcy in every five have the attention of the Cattle Commission called to them, which is a larger proportion than the Board imagined were reported to it, and shows that the law is fairly well complied with. When a case that has not previously been reported is reported to the Board by the renderer, the inspector of animals for the city or town is immediately notified to see that the premises from which the diseased animal came are thoroughly disinfected, and, if any other horses are kept there, to ascertain if they are healthy, and inform the commission of the results of the investigation.

The renderers' returns do not include Mr. Bartlett of Worcester, as he reported every case in that city directly to Commissioner Herrick, as frequently as he received them.

The cases which the Board would not otherwise have heard of were all outside of Boston, as in Boston this work is in the hands of the board of health. The co-operation of the renderers in this work has been a valuable assistance to the Board, and their willingness to help is highly praiseworthy; and, while the commission has a legal right to require these returns, yet the cheerful readiness with which they have been furnished is exceedingly commendable, and deserves the heartiest thanks of the Board, which it takes this opportunity to express.

On account of the number of cases of glanders called to the attention of the commission early in the summer, and because of the passage of the new law relating to infectious diseases of animals, it seemed important that persons should be informed as far as possible concerning the proper course to pursue in case of outbreaks of this disease. The following notice was therefore sent, about July 1 (printed in large type), to all the postmasters in the country towns in the State, to the chiefs of police in many of the larger places, and to some of the inspectors of animals in towns where glanders was specially prevalent, asking them to post it where people would see it: —

NOTICE.

Attention is hereby called to the following sections of chapter 408 of the Acts of 1899: —

SECTION 14. Whenever in any city or town the board of health or any member or agent thereof, or any other person, except the members of the board of cattle commissioners, who has knowledge of or has good reason to suspect the existence of any contagious disease among any species of domestic animals within the limits of this Commonwealth, or that any domestic animal is affected with any such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give written notice thereof to the board of cattle commissioners or any of its members, agents or inspectors, and for failure so to do shall be punished by a fine not exceeding one hundred dollars: *provided, however*, that no such notice shall be given in the city of Boston relating to the diseases known as glanders, farcy and rabies, which diseases shall be cared for by the board of health of the city of Boston.

SECTION 15. Upon the receipt of such notice from any person the board of cattle commissioners shall inspect or cause to be inspected by its authorized agent any such animal or animals, and if upon such inspection said board or such inspector suspects or has reason to believe that

contagion exists, the board or inspector shall proceed according to the provisions of sections twenty-three, twenty-four, twenty-five and twenty-six of this act.

SECTION 34. Every person who kills or causes to be killed, with the consent of the owner or person in possession thereof, any animal under suspicion that the same is affected with or has been exposed to a contagious disease, and who, upon the inspection of the carcass thereof, finds or is of the opinion that the same is affected with a contagious disease, shall notify such owner or person in possession thereof of the existence of such disease, and shall also immediately notify the board of cattle commissioners, its agent or inspector, of the same, and of the place where the animal was found, the name of the owner or owners, or person or persons in possession thereof, and of the disposal made of such carcass. Any person violating the provisions of this section shall be subject to the same penalties as are provided in section twenty-eight of this act.

SECTION 35. Contagious diseases under the provisions of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis.

Please post this in a conspicuous place.

AUSTIN PETERS, *Chairman*,
L. F. HERRICK, *Secretary*,
C. A. DENNEN,
Board of Cattle Commissioners.

BOSTON, July 1, 1899.

The reports of the Massachusetts Cattle Commission for many years have been printed in the report of the Secretary of the State Board of Agriculture. Prior to 1878 there seems to be no reference to glanders or farcy; but in that year the powers of the Cattle Commission were made to apply to horses, asses and mules affected with this disease, and the report mentions killing a few diseased animals under the act, and refers to the fact that the disease is not infrequent, and that the owners kill animals of their own free will when veterinarians inform them of its nature, and regrets that sometimes unscrupulous owners sell or trade off these beasts.

In 1879 the Board ordered 43 glandered horses killed.

In 1880, 27.

In 1881, 40 were killed by the commission.

In 1882, 10 reported killed.

In 1883, no report.

In 1884, number not given.

In 1885, 18 killed.

In 1886, 75 killed.

In 1887, much space given to report on glanders, Dr. Winchester putting in minority report.

In 1888, 76 killed.

In 1889, 57 killed by Board.

In 1890, 90 cases or suspected cases, most of them killed.

In 1891, 157 cases killed either by order of the commission or reported killed with consent of owner, or double the number in any previous year.

In 1892, 134 killed by commission or reported killed, but the report comments that many cases are killed privately and not reported, to avoid publicity.

In 1893, report does not give number of cases, but mentions disease occurring in the towns of Attleborough, Auburn, Boston, Brockton, Cambridge, Chelsea, Clinton, Concord, Everett, Fall River, Lawrence, Lowell, Milford, Millbury, Natick, Quincy, Somerville, Springfield, Taunton, Westport and Winthrop. It will be noticed that subsequent reports show it to have prevailed in these neighborhoods ever since. The report still complains of persons who fail to report cases to the Board, cheap horse traders who sell infected animals, and quack horse doctors who pretend to undertake the cure of glanders and farcy. These obstacles are still met with, and in all probability will continue to be for some years to come.

In 1894, 160 animals were condemned and destroyed, as reported to the commission.

In 1895, 206 animals condemned and killed, as reported to the Board.

In 1896, 341 animals killed by order of the Board, or with consent of owner.

In 1897, 402 animals killed by order of the Board, or with consent of the owner.

In 1898, 387 animals were killed by order of the Board, or with the consent of the owner.

In 1899, 543, as already stated.

This would show a steady and alarming increase, if it were not for the fact that probably much of this year's increase is the result of more complete returns than have ever

yet been received by the Board of Cattle Commissioners; as it is, the matter is sufficiently serious.

It is estimated by the Board that the average value of the horses killed in Massachusetts during the past year was about $78.50 per head; this means an annual loss to the horse owners of the State of over $42,000; as some cases are not reported, it means a loss of considerably more if these were included.

Glanders and farcy spread in a variety of ways: public watering troughs undoubtedly play a part in infected localities; cohabitation of the diseased and healthy; trading and selling diseased horses by cheap horse traders; and infected animals on peddlers' and advertising wagons going around the country also cause fresh outbreaks. Improper disinfection of premises, harnesses and utensils after removing diseased animals will also perpetuate the trouble.

During the past year cases have been called to the attention of the Board of persons knowingly selling glandered horses, with the result that a man in Worcester was fined $50 for selling a glandered horse, on complaint of Commissioner Herrick.

A man was fined $20 for selling a glandered horse in Palmer, the case being prosecuted by the district police, at the request of the Cattle Commission.

Two men are held for the grand jury at Salem this January in $300 each for selling a horse with farcy in Saugus, on complaint of Commissioner Peters.

A complaint has been made to the district police of a Somerville man selling the horse to one of the Saugus men by the Commission. Complaint has also been made to the district police of a man in Westminster for knowingly removing or concealing a horse with glanders. It is hoped the district police will be able to prepare and prove charges against these men.

Complaint was made to the district police of a firm of barge owners in Nahant, who sent a horse to a Boston sale stable last summer suffering with glanders, which was sold to a man in Stoneham, where it was killed by order of the Board. (Nothing seems to have come of this.)

In many of these cases the difficulty is to prove that a

man knowingly sells a horse with a contagious disease; if there is no proof that he knows or has reasonable cause to believe that the animal has a contagious disease, there is no case against them.

Complaint was made to the district police last summer of a man in Melrose who buys old horses and takes them to his place to kill. He bought two glandered horses in Boston, one from Somerville and one from Chelsea, and took them to Melrose to slaughter. A member of the commission visited the place one day, after hearing of these cases, and found a shanty in the woods, and the heads, necks and shoulders of two old horses; the hind quarters and loins were gone. The owner was not at home, but his man said the remains of the two horses were sold for fertilizer. Just why the hind quarters and loins of a horse make better fertilizer than the rest is a problem to be solved; also, what is done with them should be known. The district police watched the establishment for awhile, and concluded there was no case against him. He took another reported case of glanders there a few days ago; but, if he maintains he did not know the horse had glanders, there is no case against him.

There is a man in Malden who occasionally buys horses to kill, in the same way. The horse taken from Somerville to Saugus, where the two men now held for the court in Salem sold him from one to another, was first taken to Malden; but the horse killer would only give $2.50 for him, and one of the Saugus men offered $3, and took him home.

If there is no legislation to stop these irresponsible persons handling diseased animals, there should be. Diseased animals should all be sent to responsible rendering establishments, and the proprietors of these plants should be required by statute to report all such cases to the Cattle Commission.

As glanders and farcy prevail over Massachusetts, and every city and town forms a portion of the Commonwealth, one general law relating to contagious animal diseases should suffice for all; special legislation is pernicious when not needed, and it is to be hoped that it will not be carried any farther than it has been in regard to Boston.

It is to be hoped that a rigid enforcement of the law in the future will lead to a diminution in glanders and farcy; but at present it is a great source of loss to horse owners and a danger to the community.

A number of the doubtful cases decided by the guinea pig test were of a chronic character, that may have been spreading the disease for several months, or even longer. The killing of such animals may have an effect in lessening the number of future cases.

Rabies.

At the time of compiling the last report upon rabies, which carried up to Dec. 15, 1898, there were held in quarantine by the Cattle Commission eleven dogs which had been bitten, or were in neighborhoods where they might have been bitten, by dogs that were rabid or suspected of being afflicted with this disorder. Three of these animals were in Lynn, and had been bitten by a dog supposed to be rabid. The head of the latter was sent to the commission in October, 1898, and rabbits were inoculated with material from his brain. At the end of ninety days the rabbits were still healthy, and the three quarantined canines were released Dec. 21, 1898. The other eight still in quarantine a year ago last December were what remained from an outbreak when twelve dogs were quarantined in Newton in a neighborhood where there was a case of rabies. Two of these had died of rabies, and two had been shot by their owners as a matter of precaution at the time of making the last report. The remaining eight were still healthy Dec. 21, 1898, when the ninety-day period of quarantine expired, and they were ordered released.

Just after completing the last annual report there was an outbreak of rabies in that part of Boston known as Dorchester, near Milton Lower Mills. A dog was reported by the inspector of the Boston board of health* as having had rabies. The board of health "notified" the owners of a number of other dogs in the vicinity to keep them in quarantine. One of these animals was reported to have died of

* Under special act of 1899, he now has a legal power to quarantine dogs exposed to rabies, or horses suspected of having glanders or farcy, independently of the Cattle Commission; prior to that time he had to secure the co-operation of the commission to quarantine animals legally.

rabies December 29. One of the dogs, whose owner was "notified" to keep him in quarantine, was a setter, and was taken to Grand Isle, off Osterville in the town of Barnstable, January 4, to be used for hunting; here he was ordered quarantined by the Cattle Commission, January 4, as the result of a letter from the Boston inspector, and remained there until February 17, when his owner broke quarantine through ignorance of the law, but was not prosecuted, as he made ample apology to the Board for the misunderstanding, and promised to keep him under control until the three months was up. The dog remained healthy. No further trouble has resulted from the Boston outbreak, so far as the commission has been informed.

There were a couple of cases of rabies in Melrose in November, 1898. One of these was a strange dog, who owned him or where he came from not being known. He strayed into a prayer meeting in the Baptist Church one evening, and bit a woman on the face; she died about a month later of hydrophobia. Seeing an account of this case in the daily papers the last of December was the first intimation the Cattle Commission had of the presence of this disease in Melrose. Upon investigation, further particulars were obtained concerning this case, and it was also ascertained that another dog owned in that town died of what was supposed to be rabies in November. Two dogs which used to play with the latter were ordered quarantined, as a matter of precaution; they were kept in a state of isolation until March 2, when they were released from quarantine, still healthy. It seems that the tramp dog, which bit the woman in church, had been noticed for a couple of days in the neighborhood. After he bit the woman the Baptist minister held him so he could do no further damage, and handed him over to the police, who shut him up and then allowed him to escape; he then bit a boy, whereupon he was recaptured and shot. After learning of the danger from the woman's death, the boy went to New York and took the Pasteur preventive treatment. The Cattle Commission does not know that the police reported the suspected case of rabies in the dog to the Melrose board of health; if they did, the board of health never reported it

to the Cattle Commission, as required by law. In this instance, if the animal had been secured when it was noticed that he was a stray dog acting in a peculiar manner, he might never have bitten any one. If after biting the woman he had been kept secured and the commission notified, he would not have bitten the boy; and it might have been ascertained that the dog had rabies and had bitten a person, thus giving her an opportunity to take the Pasteur treatment and save her life, if she decided to do so.

In December, 1898, an outbreak of rabies occurred in Ipswich, but through ignorance of the law it was not reported to the commission until Jan. 16, 1899. December 4 a dog owned in this town acted in a peculiar manner, and was shot December 7, after biting one or more other dogs. One of the neighbor's dogs showed symptoms of hydrophobia December 21 and bit a dog, a horse and a cow. The cow died of rabies January 12, and was proved to have this disease, the head being sent to Dr. Frothingham, who inoculated rabbits with material from her brain, with positive results. The horse was shot by its owner, as reported to the commission January 15. The dog said to have been bitten December 21 was held in quarantine until March 16, and then released, having developed no symptoms of disease. Two more dogs were quarantined in Ipswich January 21, on account of this outbreak, but were released, still healthy, March 16, ninety days having expired without any symptoms of disease having been noticed. March 17 a St. Bernard pup was reported to the commission from Ipswich as having rabies, and was ordered killed by a member of the Board, as apparently suffering from this malady; but a rabbit test showed him to have been free from it.

As a result of the appearance of rabies in Ipswich, there came near being an outbreak on the borders of Wenham and Hamilton. A rabid dog strayed from Ipswich to the vicinity of the Myopia Club, where he was killed after biting another dog, which died March 19, showing symptoms of rabies. The latter dog's head was cut off and sent to Boston for examination. The rabbits inoculated by Dr. Frothingham gave positive results April 18. Two dogs in Hamilton and

six in Wenham were quarantined by the local inspectors as a matter of precaution, by order of the commission, all of which were released as healthy June 15.

The head of a cat thought to have been rabid was sent to Dr. Frothingham from Melrose January 19, but the rabbit test was negative.

February 7 the head of a fox terrier was sent from Swampscott on suspicion of having had rabies, but the rabbit test was negative.

April 3 a case of rabies in a dog was reported by the inspector of animals in Lowell, but this was not verified by the rabbit test.

April 5 a dog was quarantined by the local inspector in Ipswich, on suspicion, but was apparently healthy, and was released by order of the commission April 13.

June 2 the head of a dog supposed to have been rabid was sent to the commission from Lynn; one rabbit and two guinea pigs gave negative results.

August 18 a head of a dog was sent by the police department of Gloucester, but was too much decomposed when it arrived to be of value; rabbits inoculated died of septicæmia. This was a young dog recently taken to Gloucester from Boston, and there was no reason to believe he had rabies; but he bit a policeman, who went to New York and took the Pasteur treatment as a matter of safety.

August 22 the head of a dog was sent from Lynn; inoculation tests showed him to have been free from rabies.

September 20 the Worcester papers reported a case of rabies in a dog in Oxford, stating that he had bitten a horse, and was shot. Commissioner Herrick went to Oxford September 21 to investigate the matter, and learned that the dog had been shot and buried. The grave was on the edge of a pond and was dug at low water, a heavy rain had filled the pond up so that it was impossible to disinter the remains; but the collar was saved, and from this it was learned that the animal was owned in Worcester. The owner was seen, and said that he had a collie pup that had been missing for two or three days, and undoubtedly had strayed away from home and been shot. As there are no other reports of rabies from the neighborhood of Worcester, and as there is

no complaint that the horse has shown any signs of rabies, it is more than probable that this was not a case of hydrophobia.

October 24 the head of a dog was sent from Brookline; inoculation tests gave negative results.

November 13 the head of a bull terrier was sent from Swampscott, supposed to have been rabid; inoculation tests at date of writing negative. Two pigs bitten by him are still in quarantine.

November 27 the head of an ownerless dog was sent from Salem by the board of health, having been shot by a policeman, on suspicion of having rabies; results of inoculating rabbits are still negative.

From this report it will be seen that there has not been a positive case of rabies reported to the Massachusetts Cattle Commission since last March, — at least, not a case has been reported since then that has been proved to have been rabies. The few suspected cases since have been negative, so far as this Board has been able to ascertain.

In Lynn two and three years ago cases of rabies among dogs were frequent, and there had not been a time for a number of years when an occasional outbreak did not occur. Many dogs and some people were bitten, entailing quite an expense upon the latter for the Pasteur preventive treatment, which they had to go to New York to receive; and the loss of at least one life, — that of a police officer who did not realize the danger from the bite of a stray dog until too late.

There has not been a positive case of rabies in Lynn, so far as is known, since July, 1898; in the contiguous town of Swampscott there has not been a positive case since June of the same year; and in Salem, which adjoins Swampscott, there has not been a positive case, so far as this Board is aware, since February, 1898. This result seems to have been attained by the co-operation of the boards of health and inspectors of animals with the Cattle Commissioners, the efforts of the local authorities being especially commendable in Lynn and Swampscott. It shows what can be done if the matter is taken hold of in earnest. In these places suspicious cases have been at once reported to the Cattle Commission, and the heads of the dogs which have died or been

killed have been sent to the laboratory, in order to decide whether the suspected animal was or was not rabid. Exposed dogs have been quarantined for ninety days, and there has been a vigorous attempt to enforce the dog-license law, resulting in the destruction of ownerless and stray dogs. In Lynn and Swampscott a dog-muzzling order was also adopted during a portion of the spring and summer of 1898.

The quarantine regulations carried out in other localities where rabies has appeared seem to have had the desired effect of checking the spread of the disease. As there has not been a positive case reported since last March (unless the one in Lowell in April is considered positive: this was not verified), it is to be hoped that this dangerous disorder is under control, and that it may be kept so. In order to do this, the dog-license law should be thoroughly enforced in every city and town, so that every dog will have a responsible owner interested in its welfare, and that this will lead to the annual destruction of all ownerless or valueless dogs.

When a case of suspected rabies does occur, it should be at once reported to the Cattle Commission, and the dog isolated; or, if it dies, the head should at once be sent, in as fresh and clean a condition as possible, to the Board for examination. If a person is bitten, the result can be ascertained in time to inform any one whether the case is positive and it is necessary to take the Pasteur preventive treatment, or whether there is no danger, if the fresh head is sent at once and in good condition.

The bungling methods of police authorities in many cities and towns is very reprehensible, where dogs are shot and called mad without reporting the cases to the Cattle Commission, as required by law, which would take pains to ascertain whether the case is rabies or not, and, if it proves to be so, will order the adoption of necessary precautions; or, on the other hand, the police sometimes allow a strange, peculiar-acting dog to go at large without any interference on their part until it has done some actual damage. The case already cited as occurring in Melrose is a good example of the kind, where the carelessness and ignorance of the law and their duties on the part of the police led to serious results.

As has been stated in a previous report, when possible it is desirable to chloroform a dog suspected of rabies, as a bullet tears the brain to pieces and infects it with septic germs, so that it is often unfit to use for inoculating experimental animals for diagnostic purposes. As dogs may have brain troubles causing symptoms resembling rabies, it is not scientific to shoot a peculiar-acting dog and call him mad, without, if possible, verifying the diagnosis with a rabbit test, which settles the question beyond all doubt.

Texas Fever.

There have been no cases of Texas fever in Massachusetts during 1899, but the commission is always on the alert to prevent any outbreaks during the summer months.

Early in the summer the attention of the board was called to the fact that cattle were being unloaded from cars from infected districts at the Brighton Abattoir, at a point where it has always been customary to unload them for immediate slaughter; but, instead of killing them from the pens into which they were unloaded, as in previous years, they were driven down a lane back of the pens to another yard. The following placard was immediately posted upon the street along which the cattle were driven and in the pens in which they were yarded: —

Notice.

Attention is hereby called to the following sections of chapter 408 of the Acts of 1899: —

Section 35. Contagious diseases under the provisions of this act shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis.

Section 36. Any person who fails to comply with a regulation made or an order given by the Board of Cattle Commissioners or by any of its members in the discharge of its or his duty, shall be punished by a fine not exceeding five hundred dollars, or by imprisonment not exceeding one year.

Section 38. No Texan, Mexican, Cherokee, Indian or other cattle, which the cattle commissioners decide may spread contagious disease, shall be driven contrary to any order of the board of cattle commissioners, on the streets of any city, town or village, or on any road in this Commonwealth, or outside the stock yards connected with any railroad in this Commonwealth.

SECTION 39. In all stock yards within this Commonwealth said Texan, Mexican, Cherokee or other Indian cattle, which the cattle commissioners decide may spread contagious disease, shall be kept in different pens from those in which other cattle are kept.

SECTION 40. Any person or persons violating the provisions of the two preceding sections shall be punished by a fine of not less than twenty nor more than one hundred dollars.

As these pens and this street are being used for cattle from districts infected with Texas fever, the Massachusetts Cattle Commissioners forbid the bringing of any neat cattle upon these premises except those intended for immediate slaughter.

AUSTIN PETERS, *Chairman*,
L. F. HERRICK, *Secretary*,
C. A. DENNEN,
Board of Cattle Commissioners.

BOSTON, June 26, 1899.

Not long after posting this notice a man with three young cattle, a two-year-old bull, a two-year-old heifer and a yearling heifer, two of which were in a wagon, had the wagon break down near one of the pens used for the quarantined cattle, and he drove them into it while he took the wagon to be repaired. When he returned for the cattle his attention was called to the order on the fence, and he had to have them killed and take their beef value. This is all the trouble the commission has had over Texas fever the last year.

Many interesting experiments are being tried at the agricultural experiment stations in Texas, Missouri and Louisiana, in connection with the communication of Texas fever, and immunizing northern cattle of improved breeds when taken to points in the south for the purpose of improving the native stock; but in Massachusetts the main object in connection with this disease seems to be, for the present at least, to prevent its introduction during the summer months.

SYMPTOMATIC ANTHRAX.

An outbreak of symptomatic anthrax occurred in the northern part of Ashburnham in February and early in March. It was reported to the commission by Dr. O. F. Lord of Fitchburg, February 28, who wrote as follows: —

GENTLEMEN: — I learned from a reliable source that there are four cases of anthrax or black leg in the herd of John Wright of Ashburnham. As this is an adjoining town of Fitchburg, and cattle are liable to come here, I thought I would notify you, so you might act accordingly and isolate the herd, etc.

Dr. Lord's letter was duly acknowledged, and at the same time Mr. J. L. Clark, one of the inspectors of animals in Ashburnham, was written to, to investigate the matter more fully and inform the commission of the result. March 8 the following letter was received from the other inspector: —

ASHBURNHAM, MASS.

DEAR SIRS: — Mr. J. L. Clark handed me your letter of March 1, and I have been over to Mr. John A. Wright's and examined the heifer which died last night. The head and neck were swollen, and the tongue was swollen, and looked as if on the side of the tongue there had been blisters which had burst, discharging their contents and leaving a deep sore. The tongue looks very much inflamed and the cheek under the skin looks black.

Mr. Wright informs me that this makes four that he has lost, and they all seemed different. One's shoulder was swollen, another's hind legs were swollen, and the other was swollen on the back. He told me that he had removed them from the rest of the herd as soon as he found that they were sick. I could not see any symptoms of gloss-anthrax, blain, black tongue or black leg. I do not think the disease is caused by exposure or impoverished keeping, for Mr. Wright is a good feeder, and I fail to find any peculiar odor or atmospheric conditions favored by filth or poor ventilation. Mr. Wright keeps his barn clean and in good order. I think it will require your assistance to stop the disease from spreading. I asked him to leave the heifer where she now is until you can send a veterinarian to examine her.

Yours truly, C. W. WHITNEY,
Second Inspector.

After receiving this letter the chairman of the Board arranged with Dr. Langdon Frothingham to visit the farm with him March 11. Mr. Whitney met them at the South Ashburnham station with a sleigh, and with one of the selectmen drove to Mr. Wright's. The dead heifer referred to was found in an old hen house, where it had been saved

for examination. The carcass presented the appearance described in Mr. Whitney's letter; the principal lesion seemed to be a swelling under the skin of the neck and into adjoining muscles. Specimens from the neck were removed by Dr. Frothingham for microscopic examination, who reported March 14 that the heifer died of symptomatic anthrax.

At the time of the visit of the chairman of the Board and Dr. Frothingham the other cattle were examined. There were ten or a dozen cows, a few yearlings and two-year-olds left, but all seemed healthy, and the temperatures were taken and none were found to be feverish.

This is a disease peculiar to young cattle, and none of the mature ones showed symptoms of sickness at any time.

After receiving Dr. Frothingham's report, Mr. Wright was written to, as follows: —

BOSTON, March 14, 1899.

Mr. JOHN WRIGHT, *Ashburnham, Mass.*

DEAR SIR: — Dr. Frothingham informs me that your young cattle have died of symptomatic anthrax, which is caused by a spore-producing bacterium. These spores are little seeds in the germ that produce the disease, and if they get into the system of another young animal through a cut or scratch it is likely to cause the trouble to appear in that one. As these spores are very small and easily spread around, and retain their life for some time, Dr. Frothingham recommends that you be very particular about disinfecting the stable where the sick cattle were, also that there is danger of its spreading through dragging a dead animal along the ground; and that it would be well, if you have not already done so, to carefully burn the dead animals and sprinkle chloride of lime along the ground where their carcasses may have been drawn, also put chloride of lime in the hen house where the carcass lay that we saw Saturday, or else soak the ground in the hen house thoroughly with a solution of corrosive sublimate, one to one thousand parts, and also avoid having the young cattle go where the carcasses of the dead ones have been dragged over the ground.

It is not unlikely that, last season having been an unusually wet one, these germs grew and produced spores which got on some of the hay which has been cut on low-lying, swampy ground, and that they have retained their life until the hay was fed this winter. Of course this is not certain, but a mere suggestion. If there should be any hay that you are at all suspicious of, as having

come from swampy ground, perhaps it would be better to burn it than to feed it to young stock. I hope, however, that you will not have any more trouble, but think it would be better to take every precaution possible.

Also avoid taking an animal that is dead along near a brook which may flow down to a neighbor's farm, as the disease might be spread in this way to his land.

Yours truly, AUSTIN PETERS,
Chairman.

As nothing more has been reported to the commission concerning this outbreak, it is believed that there were no more cases.

The Bureau of Animal Industry at Washington prepares an attenuated virus for protective inoculation for symptomatic anthrax or "black leg" in cattle, as does also the Pasteur Company of Chicago. If any farmer should have trouble from this disease during the coming year, and will report the matter at once to the commission, the Board will obtain a supply of the material for the protective inoculation, and furnish the services of a veterinarian to see that the work is properly done. In order to be of value, the outbreak of the disease should be reported immediately, to allow time to furnish the protective treatment to susceptible animals before there is an opportunity for them to develop the malady in a fatal form.

ACTINOMYCOSIS.

Actinomycosis was added to the list of diseases to be considered contagious by the last legislature. Under the law the Cattle Commission has the power to kill animals suffering from this disease without appraisal or payment. It does not seem necessary in all cases to order such animals destroyed; but in advanced cases, where the animal is emaciated and evidently suffering from the diseased condition of the jaw bone, not only as a result of the pain, but the inability to eat, also, it seems only an act of humanity to kill such a creature and forbid the sale of the flesh.

In some cases actinomycosis or "lumpy jaw" may be associated with tuberculosis in the same animal. Occasionally it is found in the udder, and when located in this organ

it causes a nodulated state of the diseased quarter or quarters that presents clinically a condition that it is impossible to tell from tuberculosis of the mammary gland, the udder in either case having a hard, nodulated feeling, such as would be expected to be present in tuberculosis of this organ. Until the nodules of actinomycosis break and discharge their contents through the milk ducts, there is probably no danger from the use of the milk from such cows; after they do, the milk should be looked upon as unsuitable for human food until more is known about this disease.

Two cases of this character have had the attention of the Board called to them during the past year. One, a cow at Salisbury, was killed upon a physical diagnosis of tuberculosis of the udder; on post-mortem no lesions were found except in the udder, and when examined microscopically were found to be those of actinomycosis. The other occurred in Arlington. The cow was tested with tuberculin because of a nodulated udder, and reacted, and when she was killed the mediastinal glands were tuberculous, and the udder was apparently so to the naked eye; but when it was subjected to a microscopic examination the nodules were found to be actinomycosis, the reaction to tuberculin resulting from the tuberculous condition of the mediastinal glands, and not because of the nodulated condition of the udder. Guinea pigs inoculated with milk from this cow in November, before she was killed, have as yet developed no evidences of disease of any kind.

Four cows have been quarantined by the local inspectors as having actinomycosis or "lumpy jaw." One in Barnstable was killed and found to have tuberculosis associated with the other malady. Another animal in Attleborough was killed because she had actinomycosis in an advanced form. Two other cases, one in Northfield and the other in Williamstown, were released. The agent of the Board who examined the Northfield cow reported that the trouble was due to a diseased tooth; the other one was but slightly diseased and her owner was given an opportunity to fatten her, as the public good did not seem to require the immediate slaughter of the animal.

The most interesting cases of this malady are those where

it occurs in the udder; but, considering the great infrequency of this disease in man, it does not seem probable that milk can be a source through which it is communicated.

Infectious Mammitis.

Early in June the following letter was received from a farmer in Tyngsborough, who had a similar trouble in the summer of 1898: —

Tyngsborough, Mass., June 10, 1899.

Cattle Commissioners, Boston.

I lost three cows last summer with some disorder of the bag; at present I have four that are taken the same way. I can't find any one that knows anything about it. I would like some one to come and see about it. Please come to-day. I have only nine cows in all, and feel quite discouraged.

Respectfully, Paul Kelley.

The matter was referred to Dr. J. M. Parker, asking him to act as an agent of the Board of Cattle Commissioners, and he submitted the following report: —

Haverhill, June 12, 1899.

My Dear Doctor: — I went to-day to Paul Kelley's, Tyngsborough, and found he lived at Dunstable, about three miles from Tyngsborough. He has nine cows in all; four were in the barn. No. 1 is a Holstein; she comes in September 1, and has been giving six or seven quarts of milk. She became sick June 9. Her temperature is normal, 101½°; breathing slightly hurried; lame and stiff behind, so that she has difficulty in getting up; appetite poor; salivates a good deal. The right hind quarter of the udder is slightly swollen and red in color; milk secretion almost entirely suspended; and from the affected quarter there is a flow of watery fluid, containing floculi of lymph.

Cow in stall No. 3 is also Holstein; comes in September 15; has been giving about six quarts of milk; has fair appetite; temperature 103°; udder red, swollen, hard and sensitive; milk secretion practically stopped; two hind quarters secrete watery fluid; taken sick about June 7.

Cow in stall No. 5, Holstein, comes in about the end of September; has been giving eight or nine quarts; gives no milk; udder swollen, tender and red; from two hind quarters secretes watery fluid; temperature, 101°; breathing hurried, about 48; eating fairly well; taken sick about June 8.

Cow in stall No. 8, temperature, 102°; breathing fast; scouring; very lame behind; both hind limbs swollen; not much appetite; had been giving about six or seven quarts of milk; both hind quarters of udder swollen, red and tender; secreting watery fluid.

In all the udder seems to be the centre of infection. Last summer he had three affected in the same way as these; there was finally gangrene and sloughing of parts. He describes the tissue of the udder as being black. I called it "infective mastitis." I instructed him to cleanse and disinfect his barn, to give his cows a dose of salts, and advised him to feed light; prescribed peroxide of hydrogen for injection in the udder, with external applications of belladonna and camphor ointment. I also advised separation of the well cows from those affected.

If you care to have Frothingham examine milk, I will send you sample. No sores on udder.

Yours truly, JOHN M. PARKER.

SWINE DISEASES.

There was very little complaint of diseases among swine during 1899. The outbreak at Lanesborough, spoken of at the time of writing the last report, was investigated by Commissioner O'Connell. There were 17 animals quarantined, with three owners; one owner had 1, one 10 and another 8 swine. The single pig died before January 22, the other sick ones were recovering and were released January 24.

January 17, 3 swine were quarantined in West Newbury as having hog cholera. Commissioner Parker investigated this outbreak, and learned that 3 pigs had previously died; he killed 1 of the quarantined animals and ordered the other 2 killed.

March 1, a case of hog cholera was reported in a pig that died at Hardwick. The nature of the disease was discovered on post-mortem by Dr. Switzer, and specimens sent Dr. Frothingham for examination were lesions of hog cholera.

March 1, 5 swine were quarantined by the inspector of Fall River on suspicion of having tuberculosis, but investigation by a member of the Board found 2 pigs sick and 3 healthy. These pigs were fed city swill, and either had hog cholera or swine plague. They were released from quarantine April 26.

May 30, 53 swine were quarantined in Lowell as having hog cholera; they were visited by an agent of the Board

twice, and the changing of food and surroundings showed an improvement, and they were released June 28.

October 13, the inspector of North Adams quarantined 17 pigs as having hog cholera; an agent of the Board found them suffering from an infectious fever of some kind; 14 young pigs died, 3 old ones recovered and were released from quarantine November 27.

October 9, the inspector of Shelburne reported a case of hog cholera in a pig that died, but there seems to have been no further outbreak in this connection.

November 13, 2 swine were quarantined by the inspector of Swampscott because they were bitten by a dog suspected of having rabies; these have already been mentioned in the portion of the report relating to rabies.

December 9, the inspector of Beverly quarantined 26 swine, on suspicion of having hog cholera. This outbreak was investigated by an agent of the Board, and a pig killed and sent to Dr. Frothingham on post-mortem presented the appearance of hog cholera. Another pig that was sick was killed by a neighbor's dog. The rest seemed to be recovering, December 28, as a result of changing their food from city swill to grain, putting them in new pens, and separating the diseased from the healthy. They were released December 29.

Another outbreak among a herd of 23 head in Colrain is still in charge of an agent of the Board. This case is evidently traceable to feeding swill from hotels.

It will be seen from what has been stated that the course pursued in these outbreaks is to quarantine the swine, forbidding the owner to sell or buy any until his premises are again free from disease, and advising a change of food, or boiling the swill, new pens, and separating the sick from the healthy. This seems to be about all that there is to do at present, and the results appear to be fairly satisfactory.

Swine diseases do not seem to be as important in Massachusetts, where the animals are kept in small lots and closely confined, as they are in the west, where pigs run in adjoining pastures in large herds, and sick pigs on a stream pollute the water supply and lead to the infection of those lower down the water course. In some sections of the west, such

as Iowa, Missouri, Kansas and Nebraska, swine diseases are very important, and cause losses of hundreds of thousands of dollars annually.

The Bureau of Animal Industry of the United States Department of Agriculture is experimenting at the present time in an attempt to produce a serum for the protective inoculation of swine with hog cholera and swine plague, and trials made with the serums so far produced seem to have been quite successful; but so far the production of these serums has been rather expensive, and more researches will be required before arriving at an established basis.

Dr. A. T. Peters, of the Nebraska Agricultural Experiment Station, is working to produce an attenuated germ of hog cholera to use for a preventive inoculation, but his results are not yet definite.

A cause of confusion with the contagious swine diseases that are commonly spoken of as "hog cholera" is that there are two distinct infectious diseases of swine; either may be met with, especially in the east. One is hog cholera, the other swine plague; an outbreak may be one disease alone, or the two diseases may be associated in the same pig. In using a preventive virus or serum, it will first be necessary when the disease appears to decide which has to be dealt with, or whether both are present. Many times this cannot be positively decided upon unless the germs are isolated and cultivated, in order to see whether the organisms of one or the other or of both diseases are present.

Hog cholera is more a specific disease of the pig than swine plague; the former is confined to swine alone, while the latter seems to be more of an infectious pneumonia due to a germ found in putrifying swill, and may be communicated to sheep and lambs, calves and perhaps horses.

If the Board were in a position to do more for the farmer in helping him to prevent or limit outbreaks of contagious disease among swine, it is possible more reports would be received relating to them; as it is, it would appear that these diseases have not prevailed to any very alarming extent during the past year.

As has been said in previous reports, tuberculosis is not an infrequent disease among swine raised in Massachusetts, and is most frequently met with in pigs kept in cellars under cow barns on farms where tuberculosis exists in the cattle. It is not a source of great loss, as pigs are usually so young when killed that the lesions are not extensive, and it is only occasionally that one is condemned as unfit for food at the time of slaughter.

Other Diseases.

In addition to the diseases mentioned above, the commission has been called upon twice to investigate what were thought to be outbreaks of contagious disease, but which proved not to be.

June 12 a telephone message was received from the selectmen of Southborough that some of the cows in a herd were sick, and that poisoning was suspected; that an officer of the district police was investigating the matter, but they thought the Cattle Commission should investigate it also. The chairman and secretary immediately went to Southborough, and saw a herd of some 60 cows. Several had been sick and 1 had died, but the sick were improving. Samples of milk from a sick cow, taken by the commission and examined by Dr. Chas. Harrington of Boston, were found not to contain poison. Vomitus from a sick cow, taken by the State police and analyzed in Worcester, contained no common poison. As the summer was very dry and the pastures bare, it is probable the cows taken sick had eaten some weed or shrub that poisoned them, although what the plant was has not been determined.

Another case of poisoning reported to Mr. Herrick and investigated for him by C. A. Fenner occurred in Sutton, in July. Sunday, July 16, between four and five o'clock in the afternoon, 4 horses were turned out to grass on the grounds about the house, and all remained out until about nine o'clock, when 3 of the horses were put in the stable, 1 remaining out all night. Monday, July 17, about ten o'clock in the morning, 1 of the horses was noticed to be badly bloated, and discharging a white substance from the mouth and nostrils. The other 3 horses were found to be in the same condition,

and 1 died on the afternoon of the same day. The remaining 3 have so far recovered as to be able to do light work. No evidence of any contagious disease has been discovered. It is the opinion of Mr. Marsh that the horses were poisoned in the stable during the night of July 16. He believes that strychnine was put in the mangers, and that the horses ate it with their grain in the morning.

Respectfully submitted,

AUSTIN PETERS, *Chairman*,
LEANDER F. HERRICK, *Secretary*,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

REPORT OF THE DELEGATES

TO THE

FARMERS' NATIONAL CONGRESS,

AT BOSTON, MASS., 1899.

REPORT OF THE DELEGATES TO THE FARMERS' NATIONAL CONGRESS.*

AT BOSTON, MASS., 1899.

To His Excellency ROGER WOLCOTT.

SIR : — The delegates from Massachusetts to the Farmers' National Congress, which held its nineteenth annual session at Boston, Mass., Oct. 3–10, 1899, thank you for the honor of their appointment, and submit the following report.

The Congress met in Faneuil Hall, and was called to order at 10 o'clock A.M. on Oct. 3, 1899, by Hon. William D. Hoard of Wisconsin, its president. The three sessions of the first day were held in the "Old Cradle of Liberty," but, owing to a lack of facilities for heating it, the remaining sessions were held in Horticultural Hall.

Delegates and associate delegates, numbering some three hundred and fifty, were present from the New England, Middle, Southern and Middle Western States.

Prayer was offered by Rev. Henry C. Graves, assistant pastor of Tremont Temple Church, Boston.

Addresses of welcome were made by Hon. Josiah Quincy, mayor of Boston; Gen. Francis H. Appleton, on behalf of the Governor of the Commonwealth, and by E. G. Preston, Esq., secretary of the Boston Chamber of Commerce on behalf of that body.

Responses were by President Hoard, Secretary John M. Stahl of Chicago, Hon. W. G. Whitmore of Valley, Neb., and Col. B. F. Clayton of Indianola, Ia., ex-president of the Congress.

The Rev. H. C. Graves extended an invitation to the members to attend divine service at the Tremont Temple

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* This report has been transmitted to the secretary of the State Board of Agriculture by His Excellency the Governor, and, according to custom, is included in the "Agriculture of Massachusetts."

the following Sunday, and Mr. Candage of Brookline extended an invitation on behalf of the Chamber of Commerce for the members to attend a reception given by that body on the following Thursday evening at their rooms from 8 to 9 o'clock.

The president then read his annual address, a copy of which, with other papers read, can be consulted in the printed report of the Congress. A recess was then taken until 2 o'clock P.M.

At the afternoon session a committee of five persons on credentials was appointed, who reported four hundred and two delegates entitled to sit in the Congress. The Chair appointed D. C. Kolp, Esq., of Iowa Park, Tex., assistant secretary; and on finance John G. Avery, Massachusetts, W. B. Powell, Pennsylvania, G. H. Baldwin, Illinois, and T. C. Slaughter of Texas. The committee on resolutions, one from each State, was appointed, of which Mr. Candage of Massachusetts was elected chairman.

Dr. Henry H. Goodell, president of the Massachusetts Agricultural College, Amherst, read an interesting paper on "The mission of the experiment station," followed by Hon. J. W. Stockwell, secretary Massachusetts State Board of Agriculture, on "Decline of farm lands in the east: cause and remedy." These papers were freely discussed.

At the evening session resolutions were received and referred to committee on resolutions, after which Hon. Franklin Dye of New Jersey, secretary of State Board of Agriculture, read a paper on "Agricultural progress and profit." A spirited discussion followed. It was *Voted*, To accept the invitation extended by the Boston Chamber of Commerce. On motion of Mr. Dye, two verses of "My Country, 'tis of Thee," were sung, and the meeting adjourned, to meet next day, upon invitation of the Massachusetts Horticultural Society, in their Hall, Tremont Street, at 10 o'clock A.M.

WEDNESDAY, OCT. 4, 1899.

The Congress met at 10 A.M., the president in the chair.

Notice was given by the finance committee of an amendment to the constitution, "giving power to the executive

committee to determine the time and place for holding the annual meeting." Amendment adopted.

Hon. W. B. Powell of Pennsylvania read a paper on "Inventions for farmers." It is to be regretted that this able paper could not be printed with the minutes, as a copy of the manuscript was not furnished for publication.

A recess was taken until 2 P.M.

Afternoon Session.

Resolutions were received and referred. Hon. W. S. Delano of Nebraska read a paper on "Problems confronting farm life," which was ably discussed. Hon. E. F. Wetstein of Kentucky followed with an interesting paper on "Intensive gardening." The paper caused spirited discussion.

Evening Session.

Hon. J. H. Brigham, assistant secretary Department of Agriculture, Washington, D. C., addressed the Congress on "Foreign markets for farm products," which elicited a spirited discussion. Prof. Willis L. Moore, chief of the United States Weather Bureau, gave an interesting talk on "The Weather Bureau and the farmer."

Congress adjourned to 10 A.M. Thursday.

THURSDAY, OCT. 5, 1899.

Called to order at 10 A.M. by the president. Resolutions presented and referred. Col. B. F. Clayton of Iowa offered an amendment to the constitution in regard to delegates and associate delegates, which was ordered to be printed and lie over until the next Congress.

The managers of the Boston Food Fair invited the members of the Congress to attend the fair free of charge.

Hon. C. C. James, deputy minister of agriculture for Ontario, addressed the Congress on "Teaching of the elements of agriculture in the common schools." The address was listened to with marked attention. Professor James was given a vote of thanks, and voted an honorary member of the Congress.

A report of the committee on president's address was read, discussed, and it was voted that it be printed with the other reports of the Congress.

Hon. L. S. Coffin, ex-railroad commissioner of Iowa, was introduced, and read a paper on "Railway transportation." This subject was ably discussed, after which the Congress took a recess until 2 P.M.

Afternoon Session.

President Hoard in the chair.

Dr. E. B. Voorhees, director of New Jersey Agricultural Experiment Station, read a paper on "Fertilizers and their general application." Unfortunately, the manuscript of this able paper was not furnished for publication with the other reports.

Hon. James W. Robertson, commissioner of agriculture and dairying of the Dominion of Canada, addressed the Congress on "The Canadian department of agriculture." A vote of thanks was extended to Professor Robertson, and he was made an honorary member.

Mr. E. L. Furness of Furnessville, Ind., addressed the Congress on "Farming as it influences and is influenced." After a short discussion, the Congress took a recess until 7 P.M.

Evening Session.

Professor Hamilton of Pennsylvania in the chair. After routine business, Mr. Sterling Elliott, chief consul L. A. W. of Massachusetts, was called to the chair, and introduced Hon. Wm. W. Armstrong of Rochester, N. Y., who read a paper on "Advantages of State aid to farmers," after which the Congress took a recess, to attend the Chamber of Commerce reception.

On reassembling at the hall, Hon. H. T. Budd, State commissioner of public roads, New Jersey, read a paper entitled, "What New Jersey farmers think of State aid," followed by Mr. William E. McClintock of the Massachusetts Highway Commission, on "The roads built in Massachusetts by State aid."

Adjourned to Friday at 10 A.M.

FRIDAY, OCT. 6, 1899.

President Hoard in the chair.

The Governor, through General Appleton, notified the Congress that he would be pleased to receive the members in the Executive Chamber, State House, at noon. *Voted*, To accept the invitation.

Committee on resolutions reported. *Voted*, To increase the membership of the executive committee to five.

Hon. H. C. Adams, dairy and food commissioner of Wisconsin, was introduced, and read a paper on "The necessity of pure food legislation." Discussion followed.

The committee on resolutions made their final report. *Voted*, That the resolution offered by H. C. Adams of Wisconsin, on taxing oleomargarine and on a national pure food law, be the special order of business for the afternoon.

A recess was then taken until 2 P.M.

Afternoon Session.

President Hoard in the chair.

Mr. F. W. Taylor of New York called attention to the Pan-American Exposition to be held at Buffalo in 1901. The president stated that the special assignment would be taken up, and called Mr. Candage to the chair.

The resolution was read by the secretary and discussed by Messrs. David, Dawley and Flanders of New York, Hoard of Wisconsin, Stockwell of Massachusetts, Stewart of Illinois, Dye of New Jersey and others, and, after being amended, was passed.

The next order of business was the election of officers for the two years ensuing.

Governor Hoard of Wisconsin was nominated and elected president by a rising vote; R. G. F. Candage of Massachusetts was nominated and elected first vice-president; Col. John S. Cunningham of North Carolina, second vice-president; Hon. John M. Stahl of Illinois, secretary; Hon. George A. Stockwell of Rhode Island, first assistant secretary; Col. D. C. Kolp, Texas, second assistant secretary; Mr. Edward A. Callahan, New York, third assistant secretary; Levi Morrison, Pennsylvania, treasurer. Executive

committee: Col. B. F. Clayton, Iowa; Mr. E. L. Furness, Indiana; Mr. W. G. Whitmore, Nebraska; Mr. E. F. Wetstein, Kentucky; Mr. T. C. Slaughter, Texas.

Assistant treasurer John G. Avery made his report, which was accepted. It was *Voted*, That the president, secretary and executive committee be a committee to revise the constitution and report at the next annual meeting.

Hon. F. D. Coburn of Kansas was introduced, and read a paper, prepared by Hon. H. R. Hilton of Topeka, on "The western tenant and his eastern landlord," after which a recess was taken until 8 P.M.

Evening Session.

Vice-President Candage in the chair.

Mr. T. C. Slaughter of Prosper, Tex., was introduced, and read an interesting paper on "Improved farming in the south."

Mr. C. S. Kelsey of Michigan offered a resolution and vote providing for a recess committee of five, to investigate and report upon the beet-sugar industry to the next Congress, which was passed. The Chair appointed on that committee Mr. C. S. Kelsey of Michigan, W. A. Henry of Wisconsin, R. M. Allen of Nebraska, Arthur Goetz of New Mexico and C. W. Norton of Iowa.

The paper of Hon. B. Walker McKeen of Maine, which was crowded from the programme for lack of time for delivery, the Congress voted to print with the proceedings, the subject being "Dairying."

The Congress then adjourned.

MONDAY, OCT. 9, 1899.

The Congress was called to order in the old State House, Boston, Vice-President Candage in the chair, W. G. Whitmore, secretary *pro tem.*, and it was *Voted*, That the vice-presidents for the States not answering the call on the 6th instant be those of the last Congress, and that their names be printed in the report.

TUESDAY, OCT. 10, 1899.

The Congress was called together at Lexington, Mass., Vice-President Candage presiding, and it was *Voted*, That Rev. Carlton A. Staples of Lexington be extended a vote of thanks for his courtesy in showing the members of the Congress the historical localities of the town connected with the Revolutionary events of April 19, 1775, and that he be made an honorary member of the Congress.

CONCORD, MASS., OCT. 10, 1899.

The Congress was called to order by the vice-president for its final session. Congratulatory speeches were made upon the satisfactory and interesting meeting of the Congress in New England, after which it was *Voted*, That the Congress adjourn *sine die*.

The excursions to Plymouth, down the harbor, to Lexington and Concord, to King's Chapel, the old State House, etc., were pleasant features of entertainment during the last days the delegates spent in and around Boston, with which they were, from a historic point of view, deeply impressed and which they highly enjoyed.

RESOLUTIONS PASSED.

To further extend rural mail delivery.

Against appropriations by the United States Congress for irrigation of lands.

In favor of the members of this Congress writing to their members of the United States Congress and members of Legislatures, urging the passage of measures passed by this Congress.

To prevent false branding of dairy products.

To urge the Congress of the United States to aid in exterminating the gypsy moth pest.

To prevent the spread of tuberculosis among cattle.

Against unjust freight rate discrimination.

Thanks of this Congress to the Boston and Associate Press.

On the upbuilding of the American merchant marine.

That the United States Congress pass laws subjecting oleomargarine, butterine, imitations of butter and cheese not

the products of pure milk to the laws of the State or Territory to which they are transported.

That the States be urged to support in a greater degree the public school system.

That the executive committee consider the question of this organization meeting at Buffalo in 1901.

The passage by the United Stated Congress of a national pure food law.

To investigate and report at the next annual meeting of this body, by a committee, the beet-sugar industry.

Against false branding of maple sugar and syrup.

Thanks to Mayor Quincy, General Appleton and other gentlemen for the cordial welcome to us to this time-honored metropolis of New England.

To the Massachusetts Legislature, the first State Legislature to make an appropriation for the purpose of entertaining the Farmers' National Congress.

To the State Board of Agriculture, its officers and members, for courteous attention to us.

To His Excellency Roger Wolcott and the officials at the State House for the reception extended to us.

To the Chamber of Commerce and its officials for their hearty welcome.

To the managers of Faneuil Hall for the never-to-be-forgotten privilege of holding our first day's session within those historic walls.

To the Massachusetts Horticultural Society, in whose building we have held our sessions for the past three days.

To owners or managers of points of interest in and near Boston who have afforded our members such pleasant and profitable visits.

To all who, by complying with the requests of our executive committee, have so ably discharged the parts assigned them.

To the ladies of Boston who have extended courtesies to the ladies of the Farmers' Congress.

To Messrs. Candage and Avery we wish to express our gratitude for their untiring efforts in our behalf, and to all who assisted them; and we shall carry to our homes the pleasantest recollections of our visit to Boston.

These resolutions can be consulted in full in the printed reports of the Congress.

The character of the proceedings of the Congress, the papers read before it and the resolutions passed stamp it as not behind that of any of the annual meetings of the body. The success of the meeting was largely due to the efforts of the executive committee, the committee appointed by the Massachusetts Board of Agriculture, Hon. George A. Stockwell of Providence, R. I., the generous appropriation by the State of Massachusetts of one thousand dollars in aid of the expense incurred, and to the officers of the Congress working in harmony for that end.

Respectfully submitted,

R. G. F. CANDAGE,
For the Delegates.

BOSTON, Dec. 22, 1899.

FINANCIAL RETURNS

AND

ANALYSES OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1899.

RETURNS OF SOCIETIES.

AMESBURY AND SALISBURY AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1881, Acts of 1881, chapter 204.

Originally raised by contribution, $1,002.32; now has $8,121.97 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,180.13: real estate, $7,716.69; crockery, tables, etc., $405.28; bills due and unpaid, $25; cash on hand, $33.16. Total liabilities consist of notes to the amount of $1,600. Receipts in 1899, $3,045.45: bounty, $600; new members, $27; other sources, $2,418.45. Expenditures in 1899, $2,937.29: premiums and gratuities paid, $763.70; current running expenses, $145; interest, $130.98; other expenses, $1,897.61. The society offered $1,500 in premiums, awarded $773.65 in premiums and gratuities, and paid $763.70, which went to 19 cities and towns. Fifty dollars and eighty-five cents went to 5 towns outside the State. Three hundred and eighty-one persons received premiums and 112 gratuities. Under head of farms $15 was awarded and paid; under farm and pet stock $287 was awarded and $282 paid; under farm and garden products $161.15 was awarded and $158.15 paid; under dairy products $3.25 was awarded and paid; under domestic manufactures $106.35 was awarded and $102.65 paid; under agricultural implements $1 was awarded and paid; under objects strictly agricultural, not specified, $89 was awarded and $86.30 paid; under objects other than agricultural, not specified, $119.90 was awarded and $115.35 paid. The society reports 256 members, — 222 males and 34 females. Three farmers' institutes were held: at Amesbury, February 10, on "Milk" and "The hundred-dollar cow;" at Amesbury, March 3, on "Extensive agriculture" and "Travels in Texas among the farms and ranches;" and at Newbury, March 15, on "The horse's foot" and "The horse and his diseases."

BARNSTABLE COUNTY AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 114.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $1,740; now has $8,300 invested as a capital stock in real estate and bonds. Total assets, $8,732.22: real estate, $7,500; bonds, $800; cash on hand, $432.22. Total liabilities consist of mortgages or like liabilities to the amount of $3,200. Receipts in 1899, $4,112.63: bounty, $600; bonds, $20; donations, $58; other sources, $3,434.63. Expenditures in 1899, $3,680.41: premiums and gratuities paid, $1,687.65; interest, $167; other expenses, $1,825.76. The society offered $1,687.65 in premiums, and awarded and paid $1,687.65 in premiums and gratuities, which went to 6 towns. One hundred and twelve persons received premiums and 325 gratuities. Under head of farm and pet stock $423.50 was awarded and paid; under field and garden crops $40 was awarded and paid; under farm and garden products $247.65 was awarded and paid; under dairy products $5 was awarded and paid; under domestic manufactures $156.50 was awarded and paid; under trotting $800 was paid; under objects other than agricultural, not specified, $15 was awarded and paid. The society reports 532 members, — 323 males and 209 females. Three farmers' institutes were held: at Orleans, March 3, on "Practical poultry culture;" at Yarmouth, March 16, on "Fruits and flowers;" and at East Sandwich, March 23, on "Mixed farming: its advantages."

BERKSHIRE AGRICULTURAL SOCIETY.

Incorporated 1811, Acts of 1811, chapter 70.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,000; now has $12,000 invested as a capital stock in real estate. Total assets, $13,110.34: real estate, $12,000; crockery, tables, etc., $200; cash on hand, $910.34. Total liabilities, $10,203.18: outstanding bills, $1,403.18; mortgages or like liabilities, $8,800. Receipts in 1899, $8,075.12: bounty,

$70.75 ; new members, $48 ; other sources, $7,956.37. Expenditures in 1899, $8,413.11 : premiums paid, $2,417.75 ;* current running expenses, $3,509.95 ; interest, $227.80 ; other expenses, $2,257.61. The society offered $1,673.25 in premiums, and awarded $1,059.75 in premiums and paid $1,059.50, which went to 23 cities and towns. Eighty-four dollars and seventy-five cents went to 3 cities and towns outside the State. One hundred and ninety-one persons received premiums. Under head of farm and pet stock $687.50 was awarded and paid ; under farm and garden products $172.75 was awarded and paid ; under dairy products $16 was awarded and paid ; under domestic manufactures $125 was awarded and $124.75 paid ; under trotting $1,045 was paid ; under objects other than agricultural, not specified, $58.50 was awarded and paid. The society reports 939 members — 834 males and 105 females. Three farmers' institutes were held : at Lanesborough, December 15, on "Financial condition of our agricultural societies ;" at Dalton, December 22, on "The gypsy moth in the Legislature ;" and at New Lenox, December 29, on "The stabling and care of milch cows, with special reference to health and profit."

BLACKSTONE VALLEY AGRICULTURAL SOCIETY.

Incorporated 1884, Acts of 1884, chapter 48.

Originally raised by contribution $3,000 ; now has $4,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,529.08 : real estate, $4,400 ; crockery, tables, etc., $100 ; cash on hand, $29.08. Total liabilities consist of mortgages or like liabilities to the amount of $2,000. Receipts in 1899, $2,356.30 : bounty, $592.67 ; new members, $23 ; donations, $17.88 ; other sources, $1,722.75. Expenditures in 1899, $2,327.22 : premiums and gratuities paid, $541.57 ; current running expenses, $1,702.61 ; interest, $83.04. The society offered $900 in premiums, awarded $559.45 in premiums and gratuities and paid $541.57, which went to 10 cities and towns. Eighty-three persons received premiums and 17 gratuities. Under

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* $1,358.25 for 1898.

head of farms $39 was awarded and paid; under farm and pet stock $357 was awarded and $351 paid; under farm and garden products $91.35 was awarded and $88.97 paid; under dairy products $2 was awarded and paid; under domestic manufactures $28.10 was awarded and paid; under agricultural implements $2 was awarded and paid; under trotting $17 was paid; under objects other than agricultural, not specified, $23 was awarded and $13.15 paid. The society reports 562 members, — 285 males and 277 females. Three farmers' institutes were held at Uxbridge: February 2, on "Running a small farm on a large scale;" March 17, on "Good roads and how to secure them, with or without State aid;" April 26, on "Variations in the quality of milk and their causes."

BRISTOL COUNTY AGRICULTURAL SOCIETY.

Incorporated 1823, Acts of 1823, chapter 32.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,240; now has $32,000 invested as a capital stock in real estate. Total assets, $33,055.35: real estate, $32,000; crockery, tables, etc., $400; cash on hand, $655.35. Total liabilities, $11,036.63: premiums due and unpaid, $36.63; mortgages or like liabilities, $11,000. Receipts in 1899, $17,993.29: bounty, $600; new members, $80; donations, $220; other sources, $17,093.29. Expenditures in 1899, $17,337.94; premiums and gratuities paid, $6,759.64; current running expenses, $8,101.04; interest, $615; other expenses, $1,862.26. The society offered $8,141.50 in premiums, awarded $6,796.27 in premiums and gratuities, and paid $6,759.64, which went to 71 cities and towns. One thousand and two dollars and seventy-five cents went to 15 cities and towns outside the State. Seven hundred and seventy-two persons received premiums and 22 gratuities. Under head of farms $76 was awarded and paid; under farm and pet stock $1,713.75 was awarded and paid; under field and garden crops $42 was awarded and $26 paid; under farm and garden products $378.50 was awarded and paid; under dairy products $41.50 was awarded and paid; under domestic manufactures

$281.27 was awarded and $260.64 paid; under trotting $3,448 was paid; under objects other than agricultural, not specified, $610.25 was awarded and paid. The society reports 845 members, — 647 males and 198 females. Three farmers' institutes were held: at Rehoboth, February 9, on "Stabling and care of milch cows, with special reference to health and profit;" at Dighton, February 23, on "Poultry feeding for the best results" and "The business side of agriculture;" and at New Bedford, March 24, on "The history of the potato" and "Potato culture."

DEERFIELD VALLEY AGRICULTURAL SOCIETY.

Incorporated 1871, Acts of 1871, chapter 208.

Originally raised by contribution, $4,094.01; now has $9,200 invested as a capital stock in real estate. Total assets, $9,498.46: real estate, $9,200; crockery, tables, etc., $250; cash on hand, $48.46. Total liabilities consist of outstanding bills to the amount of $250. Receipts in 1899, $2,321.80: bounty, $600; new members, $26; donations, $34.90; other sources, $1,660.90. Expenditures in 1899, $1,988.44: premiums paid, $1,077.90; current running expenses, $769.52; interest, $26.02; repairs, $115. The society offered $1,388.25 in premiums, awarded $1,112.80 and paid $1,077.90, which went to 24 cities and towns. Thirty-eight dollars and fifty cents went to two towns outside the State. It is estimated that 240 persons received premiums. Under head of farm and pet stock $587.50 was awarded and $559 paid; under farm and garden products $64.80 was awarded and $62.30 paid; under dairy products $7 was awarded and paid; under domestic manufactures, $86.75 was awarded and $83.35 paid; under trotting $315 was paid; under objects other than agricultural, not specified, $51.75 was awarded and $51.25 paid. The society reports 1,118 members, — 870 males and 248 females. Three farmers' institutes were held: at Ashfield, January 14, on "The Massachusetts Agricultural College" and "The hundred-dollar cow;" at Shelburne, February 4, on "Home: its surroundings and influences" and "Food and its adulterations;" and at Buckland, December 8, on "Necessities of to-day."

EASTERN HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 156.

Originally raised by contribution, $3,000; now has $7,000 invested as a capital stock in real estate. Total assets, $7,095.45: real estate, $7,000; bills due and unpaid, $11; cash on hand, $84.45. Total liabilities, $4,797.99: outstanding bills, $1,737.99; mortgages or like liabilities, $3,060. Receipts in 1899, $2,225.35: bounty, $600; donations, $117.71; other sources, $1,507.64. Expenditures in 1899, $1,540.90: premiums and gratuities paid, $951.20; other expenses, $589.70. The society offered $1,920 in premiums, and awarded and paid $951.20 in premiums and gratuities, which went to 20 cities and towns. One hundred and thirty-three persons received premiums and gratuities. Under head of farm and pet stock $425.75 was awarded and paid; under farm and garden products $114.60 was awarded and paid; under dairy products $11 was awarded and paid; under domestic manufactures $60.35 was awarded and paid; under trotting $340 was paid; under objects other than agriculture, not specified, $16.50 was awarded and paid. The society reports 479 members, — 285 males and 194 females. Three farmers' institutes were held: at Monson, March 8, on "Grasses and forage crops" and "The past and present of the Board of Agriculture;" at Wilbraham, March 24, on "The restoration of exhausted farms by practical methods;" and at Palmer, March 30, on "Public care of epileptics in Massachusetts" and "The relation of infectious diseases to the milk supply."

ESSEX AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 25.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $9,363.66; now has $27,980 invested as a capital stock in real estate, stocks, crockery, tables, etc. Total assets, $27,980: real estate, $15,300; stocks, $12,480; crockery, tables, etc., $200. Receipts in 1899, $4,022.69: bounty, $600; stocks, $748.17; new members, $42; donations, $134.50; other sources, $2,498.02. Expenditures in 1899, $2,867: pre-

miums paid, $1,436.75; current running expenses, $674.06; interest, $509.80; other expenses, $266.39. The society awarded $1,552.45 * in premiums and paid $1,509.50,* which went to 30 cities and towns. Four hundred and fifty-three persons received premiums. Under head of farms $40 was awarded and $50 paid; under farm and pet stock $776.50 was awarded and $738.50 paid; under field and garden crops $36 was awarded and $104 paid; under farm and garden products $408.50 was awarded and $360 paid; under dairy products $8 was awarded and $1 paid; under domestic manufactures $102.95 was awarded and $140.25 paid; under agricultural implements $64 was awarded and $47 paid; under objects other than agricultural, not specified, $116.50 was awarded and $68.75 paid. The society reports 1,273 members, — 1,258 males and 15 females. Five farmers' institutes were held: at Essex, January 13, on "How to feed the dairy cow" and "Economic summer and winter feeds for milch cows;" at Newbury, February 3, on "The demands of the future on the New England farmer" and "Inducements for sticking to the old farm;" at Beverly, February 24, on "Practical poultry culture" and "How to make the farm pay;" at West Newbury, March 3, on "The constituents of commercial fruit culture" and "Market gardening and how it is practised on the large vegetable farms of Rhode Island;" and at Andover, March 17, on "Silos and ensilage" and "How to feed the milch cow."

FRANKLIN COUNTY AGRICULTURAL SOCIETY.

Incorporated 1850, Acts of 1850, chapter 104.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,768; now has $8,000 invested as a capital stock in real estate, stocks, crockery, tables, etc. Total assets, $8,342.96: real estate, $7,000; stocks, $1,000; bills due and unpaid (estimated), $300; cash on hand, $42.96. Total liabilities, $3,189: outstanding bills, $889; mortgages or like liabilities, $2,300. Receipts in 1899, $5,168.88: bounty, $600;

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* Amounts awarded for 1899; paid for 1898.

stocks, $40; donations, $140; other sources, $4,388.88. Expenditures in 1899, $6,061.44: premiums and gratuities paid, $1,224.05; interest, $175.24; other expenses, $4,662.15. The society offered $1,400 in premiums, and awarded and paid $1,224.05, which went to 29 cities and towns. Twenty-eight dollars went to 2 towns outside the State. Three hundred and eighty-five persons received premiums and 27 gratuities. Under head of farm and pet stock $919.90 was awarded and paid; under field and garden crops $53 was awarded and paid; under farm and garden products $117.75 was awarded and paid; under dairy products $10 was awarded and paid; under domestic manufactures $102.40 was awarded and paid; under objects other than agricultural, not specified, $21 was awarded and paid. The society reports about 2,300 members, — about 2,000 males and 300 females. Three farmers' institutes were held: at Shelburne, February 4, on "Food and its adulterations" and "Home: its surroundings and influences;" at Sunderland, February 9, on "Resources of New England agriculture" and "Summer and winter feeds for dairy stock;" and at Greenfield, December 23, on "Guernsey cattle."

HAMPSHIRE AGRICULTURAL SOCIETY.

Incorporated 1814, Acts of 1814, chapter 19.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,255.26; now has $4,352.43 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,447.03: real estate, $4,200; crockery, tables, etc., $152.43; cash on hand, $95.60. Total liabilities, $1,339.70: outstanding bills, $26.70; mortgages or like liabilities, $1,313. Receipts in 1899, $1,956.76: bounty, $600; new members, $32.50; donations, $77.22; other sources, $1,247.04. Expenditures in 1899, $1,861.16: premiums and gratuities paid, $605.65; current running expenses, $682.91; interest, $72.60; other expenses, $500. The society offered $846 in premiums, and awarded and paid $605.65 in premiums and gratuities, which went to 14 cities and towns. One hundred and thirty-three persons received premiums and 7 gratuities.

Under head of farm and pet stock $311.25 was awarded and paid; under field and garden crops $10 was awarded and paid; under farm and garden products $122.75 was awarded and paid; under dairy products $5 was awarded and paid; under domestic manufactures $60.65 was awarded and paid; under agricultural implements $6 was awarded and paid; under objects strictly agricultural, not specified, $70 was awarded and paid; under trotting $500 was paid; under objects other than agricultural, not specified, $20 was awarded and paid. The society reports 709 members,—516 males and 193 females. Three farmers' institutes were held: at Hadley, January 26, on "How to make Massachusetts agriculture more profitable" and "Insects injurious to fruit trees;" at Sunderland, February 9, on "Resources of our New England farms" and "The care of dairy stock, including winter feeding;" and at Belchertown, March 14, on "Fruit growing in New England hill towns," "Running a small farm on a large scale" and "Following my wife's advice."

HAMPSHIRE, FRANKLIN AND HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 125.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $8,141.29; now has $1,986.22 invested as a capital stock in personal property. Total assets, $1,986.22: real estate lease, $500; bank funds, $420.08; crockery, tables, etc., $1,000; cash on hand, $66.14. Total liabilities consist of outstanding bills to the amount of about $175. Receipts in 1899, $2,518.50: bounty, $507.19; new members, $44; other sources, $2,680.53. Expenditures in 1899, $3,571: premiums and gratuities paid, $991.25; current running expenses, $2,518.50; other expenses, $61.25. The society offered in premiums $1,657.50, awarded $1,090.75 in premiums and gratuities and paid $991.25, which went to 23 cities and towns. Twenty-two dollars went to 1 city outside the State. One hundred and sixty-seven persons received premiums and 23 gratuities. Under head of farms $75 was awarded and paid; under farm and pet stock $727

was awarded and $674 paid; under farm and garden products $172.50 was awarded and $164.50 paid; under dairy products $16 was awarded and $9.50 paid; under domestic manufactures $50.75 was awarded and $38.25 paid; under agricultural implements $25 was awarded and $13.50 paid: under trotting $795 was paid; under objects other than agricultural, not specified, $24.50 was awarded and $16.50 paid. The society reports 1,064 members, — 840 males and 224 females. Three farmers' institutes were held: at Northampton, January 4, on "The new farmer;" at Hadley, January 26, on "How Massachusetts farming is to be made profitable" and "Insects injurious to fruit trees;" and at Williamsburg, March 1, on "Apple culture" and "The resources of a New England farm."

HIGHLAND AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 145.

Originally raised by contribution, $3,262; now has $3,120 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $3,165.42: real estate, $3,000; crockery, tables, etc., $120; cash on hand, $45.42. Receipts in 1899, $1,698.50: bounty $600; new members, $7; other sources, $1,091.50. Expenditures in 1899, $1,653.08: premiums and gratuities paid, $683.10; current running expenses, $952.15; interest, $4.66; other expenses, $13.17. The society offered $879.40 in premiums, and awarded and paid $683.10 in premiums and gratuities, which went to 21 cities and towns. One hundred and forty-four persons received premiums and 1 a gratuity. Under head of farm and pet stock $417 was awarded and paid; under field and garden crops $28 was awarded and paid; under farm and garden products $45.25 was awarded and paid; under dairy products $7.50 was awarded and paid; under domestic manufactures $80.35 was awarded and paid; under agricultural implements $5 was awarded and paid; under trotting $80 was paid; under objects other than agricultural, not specified, $20 was awarded and paid. The society reports 387 members, — 264 males and 123 females. Three farmers' institutes were held: at Becket, January 25, on "Wrong methods

of hay making and feeding" and "Good roads, with or without State aid;" at Middlefield, February 25, on "Breeding dairy stock;" and at Middlefield, September 6, on "Mixed farming."

HILLSIDE AGRICULTURAL SOCIETY.

Incorporated 1883, Acts of 1883, chapter 112.

Originally raised by contribution, $3,113.32; now has $5,614.09 invested as a capital stock in real estate, bank funds, cash, crockery, tables, etc. Total assets, $5,614.09: real estate, $4,500; bank funds, $515; crockery, tables, etc., $350; cash, $249.09. Receipts in 1899, $1,527.67: bounty, $600; bank funds, $33.26; new members, $105; donations, $16.99; other sources, $772.42. Expenditures in 1899, $1,223.04: premiums paid, $777.85; current running expenses, $445.19. The society offered $800 in premiums, and awarded and paid $777.85, which went to 17 cities and towns. Two hundred and seventy-one persons received premiums. Under head of farm and pet stock $451 was awarded and paid; under field and garden crops $41.75 was awarded and paid; under farm and garden products $73.65 was awarded and paid; under dairy products $12.50 was awarded and paid; under domestic manufactures $46.15 was awarded and paid; under agricultural implements $3 was awarded and paid; under trotting $50 was paid; under objects other than agricultural, not specified, $40.65 was awarded and paid. The society reports 669 members, — 633 males and 36 females. Three farmers' institutes were held: at Ashfield, January 14, on "The advantages of the Massachusetts Agricultural College" and "The hundred-dollar cow;" at Plainfield, January 21, on "A trip to Europe" and "Reminiscences of the Orient;" and at Williamsburg, March 1, on "Apple culture" and "The resources of a New England farm."

HINGHAM AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 99.

Originally raised by contribution, $17,406.15; now has $22,000 invested as a capital stock in real and personal estate. Total assets, $22,002.59: real estate, $20,000;

crockery, tables, etc., $2,000; cash on hand, $2.59. Total liabilities consist of notes to the amount of $340. Receipts in 1899, $2,167.60: bounty, $600; new members, $20; donations, $54.55; other sources, $1,493.05. Expenditures in 1899, $2,298.83: premiums and gratuities paid, $656.60; current running expenses, $771.04; interest, $16.85; other expenses, $854.34. The society offered $1,727.50 in premiums, and awarded and paid $656.60 in premiums and gratuities, which went to 18 cities and towns. One hundred and sixteen persons received premiums and 128 gratuities. Under farm and garden products $531.25 was awarded and paid; under dairy products $5 was awarded and paid; under domestic manufactures $72.50 was awarded and paid; under objects strictly agricultural, not specified, $47.75 was awarded and paid. The society reports 671 members, — 478 males and 193 females. Eight farmers' institutes were held at Hingham: January 23, on "Care of lawns," "Varieties of potatoes to cultivate," "About trees in highways" and "Cultivation of cherries;" March 27, on "Pruning of grape vines," "Raspberry culture" and "Value of sea manure;" April 24, on "General fruit culture;" May 22, on "Gardens, fields and woods of Japan;" June 19, on "Native evergreens of Hingham" and "A visit to Virginia;" July 17, on "Results from seeds from the agricultural department," "Varieties of fruits to grow for profit" and "Is it profitable to raise corn in Hingham?" August 14, on "Winter covering of strawberry plants," "Protection of trees in highways from electric wires" and "Wood ashes as a fertilizer for vegetables;" November 13, on "The Hawaiian Islands."

HOOSAC VALLEY AGRICULTURAL SOCIETY.

Incorporated 1860, Acts of 1860, chapter 56.

Originally raised by contribution, $2,006; now has $15,000 invested as a capital stock in real estate. Total assets, $15,842.92: real estate, $15,000; crockery, tables, etc., $500; cash on hand, $342.92. Total liabilities, $8,800: outstanding bills, $300; mortgages or like liabilities, $8,500. Receipts in 1899, $4,181.14: bounty, $600; other sources,

$3,581.14. Expenditures in 1899, $6,562.62: premiums paid, $1,257.61; current running expenses, $1,079,38; interest, $334.80; other expenses, $3,890.83. The society offered $2,905 in premiums and awarded and paid $1,257.61, which went to 22 cities and towns. Two hundred thirty-three dollars and seventy-five cents went to 5 cities and towns outside the State. Two hundred and fifty-three persons received premiums. Under head of farms $18 was awarded and paid; under farm and pet stock $648 was awarded and paid; under field and garden crops $177 was awarded and paid; under farm and garden products $154 was awarded and paid; under dairy products $22.50 was awarded and paid; under domestic manufactures $332.25 was awarded and paid; under agricultural implements $20 was awarded and paid; under objects other than agricultural, not specified, $135.50 was awarded and paid. The society reports 980 members, — 964 males and 16 females. Three farmers' institutes were held: at Williamstown, February 16, on "Taxation" and "The management and improvement of country roads;" at Clarksburg, December 27, on "Profitable farming;" and at Cheshire, December 28, on "The gypsy moth."

HOUSATONIC AGRICULTURAL SOCIETY.

Incorporated 1848, Acts of 1848, chapter 101.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $6,335.33; now has $24,275.11 invested as a capital stock in real estate, stocks and bank funds. Total assets, $25,044.98: real estate, $22,000; stocks, $1,000; bank funds, $1,275.11; crockery, tables, etc., $475; bills due and unpaid, $50; cash on hand, $244.40. Total liabilities, $5,961.50: premiums due and unpaid and outstanding bills (estimated), $50; notes and interest, $5,911.55. Receipts in 1899, $11,028.83: bounty, $600; stocks, $50; bank funds, $46.58; new members, $223; other sources, $10,109.28. Expenditures in 1899, $10,788.39: premiums and gratuities paid, $4,869.55;*

* Premiums for 1898, $76.50; for 1899, $2,126.50; for trotting, $1,805; for sports, etc., $866.55.

current running expenses, $3,587.40; interest, $200; other expenses, $2,101.44. The society offered $2,136.50 in premiums, and awarded and paid $2,126.50 in premiums and gratuities, which went to 17 cities and towns. Four hundred and ninety-six persons received premiums and gratuities. Under head of farm and pet stock $1,129.95 was awarded and paid; under field and garden crops $238 was awarded and paid; under farm and garden products $261.50 was awarded and paid; under dairy products $41 was awarded and paid; under domestic manufactures $323.25 was awarded and $313.25 paid; under trotting $1,805 was paid; under objects other than agricultural, not specified (including sports), $766.75 was awarded and paid. The society reports 1,550 members, — 1,504 males and 46 females. Three farmers' institutes were held at Great Barrington: February 23, on "Practical poultry culture;" November 23, on "Marketing farm products;" and December 15, on "Capital and labor on the farm" and "Apple culture."

MANUFACTURERS AGRICULTURAL SOCIETY OF NORTH ATTLEBOROUGH.

Incorporated 1896, Acts of 1896, chapter 260.

Originally raised by contribution, $10,000; now has $10,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10,464.55: real estate, $9,500; crockery, tables, etc., $500; cash on hand, $464.55. Receipts in 1899, $650: bounty, $600; other sources, $50. Expenditures in 1899, $239.10: premiums paid (through Bristol County Agricultural Society), $205; current running expenses, $25.10; other expenses, $9. The society offered, awarded and paid $205 in premiums. Under head of farms $30 was awarded and paid; under farm and pet stock $125 was awarded and paid; under farm and garden products $50 was awarded and paid. The society reports 109 members, — 59 males and 50 females. Three farmers' institutes were held at Attleborough: February 28, on "Dairying;" May 10, on "Experiment work in farm and garden;" and October 25, on "Following my wife's advice."

MARSHFIELD AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 116.

Originally raised by contribution, $3,755.43; now has $27,980.08 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $27,980.08: real estate, $26,472.78; crockery, tables, etc., $1,507.30. Total liabilities, $3,257: premiums due and unpaid, $47; mortgages or like liabilities, $3,210. Receipts in 1899, $3,547.50: bounty, $600; new members, $660; donations, $345; other sources, $1,942.50. Expenditures in 1889, $4,134.03: premiums and gratuities paid, $1,032.45; current running expenses, $1,005; interest, $241.50; other expenses, $1,855.08. The society offered $1,531.90 in premiums, awarded $1,108.80 in premiums and gratuities and paid $1,032.45, which went to 24 cities and towns. Seventy-two persons received premiums and 300 gratuities. Under head of farms $11 was awarded and paid; under farm and pet stock $183.60 was awarded and $165.30 paid; under farm and garden products $188.80 was awarded and $167.55 paid; under domestic manufactures $120.40 was awarded and $117.85 paid; under trotting $605 was paid. The society reports 881 members, — 573 males and 308 females. Three farmers' institutes were held at Marshfield: January 17, on "Market gardening;" February 14, on general subjects; March 14, on "Fertilizers and stable manure" and "The trials and discouragements of the farmer;" and April 15, on "Soils: their physical and chemical character."

MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 33.

Originally raised by contribution, $4,552.17; now has $4,281.73 invested as a capital stock in real estate, notes, bank funds, crockery, tables, etc. Total assets, $4,350.35: real estate, $2,750; notes, $350; bank funds, $931.73; crockery, tables, etc., $250; cash on hand, $68.62. Total liabilities consist of outstanding bills to the estimated amount of $26. Receipts in 1899, $1,148.24: bounty, $600; notes,

$54.83 ; bank funds, $40.87 ; donations, $9.60 ; other sources, $442.94. Expenditures in 1899, $1,194.03 : premiums and gratuities paid, $710.86 ; current running expenses, $286.21 ; other expenses, $196.96. The society offered $770.25 in premiums, and awarded and paid $710.86, which went to 5 towns. Three hundred and nine persons received premiums and 96 gratuities. Under head of farms $5 was awarded and paid; under farm and pet stock $248.50 was awarded and paid; under field and garden crops $39.50 was awarded and paid; under farm and garden products $223.48 was awarded and paid; under dairy products $12 was awarded and paid; under domestic manufactures $182 was awarded and paid; under objects other than agricultural, not specified, $16.50 was awarded and paid. The society reports 190 members, — 103 males and 87 females. Three farmers' institutes were held at West Tisbury : April 21, on "Corn culture;" August 2, on "Best methods of cultivation of field crops;" and September 21, on "Our duties as citizens of the island."

MASSACHUSETTS HORTICULTURAL SOCIETY.

Incorporated 1829, Acts of 1829, chapter 22.

The first investment was from surplus, Jan. 16, 1835, and amounted to $525. The society now has $247,000 invested as a capital stock in real estate, furniture and library. Total assets, $702,834.54 : real estate, $475,000 ; library, $39,112.47 ; bonds, $156,202.25 ; crockery, tables, etc., $7,975.50 ; bills due and unpaid, $624.05 ; cash on hand, $23,920.27. Total liabilities, $233,349.60 : premiums due and unpaid, $8,349.60 ; mortgages or like liabilities, $225,000. Receipts in 1899, $61,365 : bounty, $600 ; bonds, $6,445 ; bank funds, $178.74 ; new members and assessments, $4,852 ; donations, $15,791.24 ; other sources, $33,498.02. Expenditures in 1899, $51,551.33 : premiums and gratuities paid, $7,428.25 ; current running expenses, $21,599.43 ; interest, $4,136.40 ; other expenses, $18,387.25. The society offered $8,180 * in premiums, awarded $7,442.25 * in premiums and gratuities and paid $7,428.25, which went to 72 cities and

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* Offered and awarded in 1898; paid in 1899.

towns. Two hundred and one dollars went to 9 cities and towns outside the State. One hundred and eighty-seven * persons received premiums and 111 * gratuities. Under head of farms $562 was awarded and $785 paid; under farm and garden products, $6,923.50 was awarded and $6,770 paid. The society reports 860 members, — 774 males and 86 females. Nine farmers' institutes were held in Horticultural Hall, Boston: January 28, on "The way to grow good peaches;" February 11, on "The spread of noxious insects;" February 18, on "Why crops must have nitrogen, and how it can be provided;" February 25, on "Massachusetts agriculture;" March 4, on "The peculiar fruit year of 1898;" March 11, on "Market gardening;" March 18, on "Horticulture in Japan;" and March 25, on "The actual and the possible in making roadsides beautiful."

MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE.

Incorporated 1792, Acts of 1792, chapter 33.

This society made no returns to the Board of Agriculture in 1899.

MIDDLESEX NORTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 315.

Originally raised by contribution, $3,000; now has $45,000 invested as a capital stock in real estate. Total assets, $45,730: real estate, $45,000; crockery, tables, etc., $350; cash on hand, $380. Total liabilities, $9,098.50: premiums due and unpaid, $98.50; mortgages or like liabilities, $9,000. Receipts in 1899, $3,320.10: bounty, $600; new members, $15; other sources, $2,705.10. Expenditures in 1899, $3,488.30: premiums and gratuities paid, $678.80; current running expenses, $1,241.30; interest, $405; other expenses, $1,163.20. The society offered $1,283.65, in premiums, awarded $777.30 in premiums and gratuities and paid $678.80, which went to 14 cities and towns. One hundred and fifty-seven persons received premiums and 109 gratuities. Under

* Not including school gardeners.

head of farm and pet stock $373 was awarded and $324.50 paid; under farm and garden products $263 was awarded and $237.80 paid; under dairy products $5 was awarded and paid; under domestic manufactures $78 was awarded and $68.50 paid; under agricultural implements $5 was awarded and paid; under objects strictly agricultural, not specified, $20 was awarded and paid; under trotting $510 was paid; under objects other than agricultural, not specified, $18 was awarded and paid. The society reports 922 male members; number of female members not known. Four farmers' institutes were held: at Westford, January 11, on "Grasses and forage crops;" at Dracut, February 8, on "Practical poultry culture" and "Home: its surroundings and influences;" at Tewksbury, February 24, on "Necessities of to-day" and "Flowers for amateurs, in doors and out;" and at Billerica, October 25, on "The new agriculture; or, a system of farming for success."

MIDDLESEX SOUTH AGRICULTURAL SOCIETY.

Incorporated 1854, Acts of 1854, chapter 84.

Originally raised by contribution, $3,000; now has $13,000 invested as a capital stock in real estate. Total assets, $13,200: real estate, $13,000; crockery, tables, etc., $200. Total liabilities consist of mortgages or like liabilities to the amount of $7,700. Receipts in 1899, $1,585.86: bounty, $300.90; donations, $45.25; other sources, $1,239.71. Expenditures in 1899, $1,552.12: premiums and gratuities paid, $759.25; current running expenses, $585.37; interest, $207.50. The society offered $1,523.75 in premiums, and awarded and paid $759.25 in premiums and gratuities, which went to 8 cities and towns. Ninety-one persons received premiums and 22 gratuities. Under head of farms $17 was awarded and paid; under farm and pet stock $203.75 was awarded and paid; under farm and garden products $87.65 was awarded and paid; under domestic manufactures $43 was awarded and paid; under trotting $400 was paid; under objects other than agricultural, not specified, $7.75 was awarded and paid. The society reports 561 members, — 355 males and 206 females. Three farmers' institutes were held: at Sudbury, February

24, on "How to make New England agriculture more profitable;" at Hopkinton, March 1, on "Hygiene of farm animals: or, how to prevent disease;" and at Hudson, March 2, on "Dairy cattle."

NANTUCKET AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 25.

Originally raised by contribution, $3,500; now has $3,200 invested as a capital stock in real estate. Total assets, $3,837.89: real estate, $3,200; bills due and unpaid, $600.22; cash on hand, $37.67. Total liabilities consist of outstanding bills to the amount of $627.50. Receipts in 1899, $629: bounty, $600; new members, $29. Expenditures in 1899, $1,241.39: premiums and gratuities paid, $656.75; current running expenses, $584.64. The society offered $1,265 in premiums and awarded and paid $656.75 in premiums and gratuities, which went to 1 town. Two hundred and six persons received premiums and 75 gratuities. Under head of farms $12 was awarded and paid; under farm and pet stock $343.50 was awarded and paid; under field and garden crops $8.50 was awarded and paid; under farm and garden products $97.25 was awarded and paid; under dairy products $3 was awarded and paid; under domestic manufactures $61.25 was awarded and paid; under trotting $80 was paid; under objects other than agricultural, not specified, $50.50 was awarded and paid. The society reports 536 members, — 222 males and 314 females. Three farmers' institutes were held at Nantucket: April 7, on "Dairy milk;" November 18, on general farm topics; and December 2, on "Manures and commercial fertilizers."

OXFORD AGRICULTURAL SOCIETY.

Incorporated 1888, Acts of 1888, chapter 93.

Originally raised by contribution, $4,400; now has $8,662.39 invested as a capital stock in real estate, bank funds, crockery, tables, etc. Total assets, $8,662.39: real estate, $7,650; crockery, tables, etc., $200; cash on hand, $812.39. Receipts in 1899, $3,623.17: bounty, $600; new

members, $46 ; donations, $20.50 ; other sources, $2,956.67. Expenditures in 1899, $2,210.78 : premiums paid, $1,394.33 ; current running expenses, $250 ; other expenses, $566.45. The society offered $1,800 in premiums, awarded $1,443.25 and paid $1,394.33, which went to 19 cities and towns. One hundred and twelve persons received premiums. Under head of farms $45 was awarded and paid ; under farm and pet stock $643 was awarded and $613.47 paid ; under field and garden crops $46 was awarded and $39.40 paid ; under farm and garden products $24.50 was awarded and $21.09 paid ; under dairy products $8 was awarded and $6.50 paid ; under domestic manufactures $28 was awarded and $22.80 paid ; under trotting $635 was paid ; under objects other than agricultural, not specified, $13.75 was awarded and $11.07 paid. The society reports 627 members, — 345 males and 282 females. Three farmers' institutes were held : at Auburn, January 27, on "How to make New England agriculture more profitable ;" at Sutton, April 12, on "Japan and Japanese farming ;" and at Oxford, November 28, on "Fruits."

PLYMOUTH COUNTY AGRICULTURAL SOCIETY.

Incorporated as the Agricultural Society in the County of Plymouth, 1819, Acts of 1819, chapter 2; name changed to Plymouth County Agricultural Society in 1870, Acts of 1870, chapter 251.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $9,550 ; now has $1,595.12 invested as a capital stock in notes, bank funds, bills due, crockery, tables, etc., and cash on hand. Total assests, $1,595.12 : notes, $50 ; bank funds, $1,313 ; crockery, tables, etc., $37 ; bills due and unpaid, $100 ; cash on hand, $95.12. Total liabilities consist of outstanding bills to the amount of $171.29. Receipts in 1899, $8,898.22 : bounty, $600 ; donations, $730.90 ; other sources, $7,567.32. Expenditures in 1899, $7,453.10 : premiums paid, $337.70 ; current running expenses, $437.60 ; interest, $508.96 ; other expenses, $6,168.84. The society offered $828.50 in premiums, awarded $330.20 and paid $337.70 (including $7.50 awarded in 1898), which went to 6 cities and towns. Sev-

enty-five persons received premiums. Under head of farm and pet stock $33 was awarded and paid; under field and garden crops $7.50 was paid; under farm and garden products $106 was awarded and paid; under domestic manufactures $133.20 was awarded and paid; under objects strictly agricultural, not specified, $20 was awarded and paid; under objects other than agricultural, not specified, $38 was awarded and paid. The society reports 1,465 members, — 840 males and 625 females. Three farmers' institutes were held: at Middleborough, February 10, on "The composition and economical use of chemical and farm manures;" at West Bridgewater, March 17, on "Farming forward;" and at Bridgewater, December 19, on "The dairy decalogue."

SPENCER FARMERS' AND MECHANICS' ASSOCIATION.

Incorporated 1888, Acts of 1888, chapter 87.

Originally raised by contribution, $4,034.08; now has $8,950 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $9,016.46: real estate, $8,000; crockery, tables, etc., $950; cash on hand, $66.46. Total liabilities consist of mortgages or like liabilities to the amount of $700. Receipts in 1899, $2,473.46: bounty, $600; new members, $20; other sources, $1,853.46. Expenditures in 1899, not reported. The society offered $2,000 in premiums, awarded $1,369.35 and paid $1,333.60, which went to 17 cities and towns. One hundred and forty-five persons received premiums. Under head of farms $27 was awarded and paid; under farm and pet stock $599.70 was awarded and $569.20 paid; under field and garden crops $30.50 was awarded and paid; under farm and garden products $87.50 was awarded and paid; under dairy products $9 was awarded and paid; under domestic manufactures $44 was awarded and paid; under trotting $575 was paid; under objects other than agricultural, not specified, $20.25 was awarded and paid. The society reports 802 members, — 479 males and 323 females. Three farmers' institutes were held: at Brookfield, March 11, on "Roads and roadside improvements" and "What I heard and saw at the Farmers'

National Congress at Fort Worth;" at North Brookfield, March 16, on "Reminiscences of the Orient" and "The Babcock tester;" and at Spencer, March 19, on "Obstacles to successful farming, and how to overcome them."

UNION AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 110.

Originally raised by contribution, $4,447.23; now has $9,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets $9,086.90: real estate, $8,000; crockery, tables, etc., $1,000; cash on hand, $86.90. Total liabilities, $1,843.95: premiums due and unpaid, $35.55; outstanding bills, $158.40; mortgages or like liabilities, $1,650. Receipts in 1899, $2,777.71: bounty, $600; new members, $50; other sources, $2,127.71. Expenditures in 1899, $2,690.81: premiums and gratuities paid, $1,440.95; current running expenses, $941.82; interest, $103.13; other expenses, $204.91. The society offered $2,060.70 in premiums, awarded $1,476.50 in premiums and gratuities and paid $1,440.95, which went to 24 cities and towns. Seven dollars and sixty-three cents went to four towns outside the State. One hundred and eighty-eight persons received premiums and 93 gratuities. Under head of farms $5 was awarded and paid; under farm and pet stock $527.50 was awarded and $506.23 paid; under field and garden crops $64.50 was awarded and paid; under farm and garden products $48.25 was awarded and $46.75 paid; under dairy products $10.75 was awarded and paid; under domestic manufactures $112.45 was awarded and $100.32 paid; under agricultural implements $7.25 was awarded and paid; under objects strictly agricultural, not specified, $97 was awarded and paid; under trotting $580 was paid; under objects other than agricultural, not specified, $23.80 was awarded and $23.15 paid. The society reports 1,338 members, — 615 males and 723 females. Three farmers' institutes were held at Blandford: January 6, on "Successes and failures of the year;" January 25, on "The business side of farming;" and May 5, on "The school and the State."

WEYMOUTH AGRICULTURAL AND INDUSTRIAL SOCIETY.

Incorporated 1891, Acts of 1891, chapter 77.

Amount originally raised by contribution had increased in 1891 to $10,270; now has $11,270 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $11,768.82: real estate, $11,000; crockery, tables, etc., $270; bills due and unpaid, $71.77; cash on hand, $427.05. Total liabilities, $1,690.47: outstanding bills, $190.47; mortgages or like liabilities, $1,500. Receipts in 1899, $8,704.64: bounty, $600; other sources, $8,104.64. Expenditures in 1899, $7,693.96: premiums and gratuities paid, $723.10; current running expenses, $150; interest, $158.08; other expenses, $6,662.78. The society offered $1,203.80 in premiums, awarded $736.15 in premiums and gratuities and paid $723.10 which went to 29 cities and towns. Three hundred and seventy-five persons received premiums and 250 gratuities. Under head of farm and pet stock $377.85 was awarded and $377.60 paid; under field and garden crops $8 was awarded and paid; under farm and garden products $161.70 was awarded and $154.95 paid; under domestic manufactures $123.05 was awarded and $117.10 paid; under children's department $15.45 was awarded and paid; under trotting $942.50 was paid; under objects other than agricultural, not specified, $50 was awarded and paid. The society reports 498 members, — 492 males and 6 females. Three farmers' institutes were held: at North Weymouth, April 28, on "Vegetables;" at South Weymouth, May 26, on "Soil and fertilizers;" and at South Weymouth, October 5, on "A dollar in breeding."

WORCESTER AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 163.

The society in its first report to the Board in 1853 stated that the amount of its permanent fund (par value) was $7,730; now has $116,714.67 invested as a capital stock in real estate, bank funds, crockery, tables, etc. Total assets, $116.714.67: real estate, $51,589.46; bank funds, $64,525.21; crockery,

tables, etc., $600. Receipts in 1899, $124,924.60: bounty, $600; bank funds, $413.89; new members, $80; other sources, $123,830.71. Expenditures in 1899, $9,042.34: premiums paid, $601; current running expenses, $900.11; interest, $3,770.46; other expenses, $3,770.77. The society offered $635.50 in premiums, and awarded and paid $601, which went to 13 cities and towns. Sixty-five persons received premiums. Under head of farm and pet stock $125 was awarded and paid; under field and garden crops $176 was awarded and paid; under farm and garden products $305 was awarded and paid; under dairy products $75 was awarded and paid. The society reports 1,813 members, — 1,651 males and 162 females. Three farmers' institutes were held: at Worcester, January 26, on "The agricultural and horticultural products of Turkey" and "Good hay crops, and how to secure them;" at Worcester, March 31, on "Economical dairying;" and at Westborough, April 6, on "Breeding, care and management of domestic poultry" and "The new agriculture: or, a system of farming for success."

WORCESTER EAST AGRICULTURAL SOCIETY.

Incorporated 1890, Acts of 1890, chapter 41.

Originally raised by contribution, $2,296.23; now has $6,243.77 invested as a capital stock in real estate, bank funds, crockery, tables, etc. Total assets, $6,243.77: real estate, $5,181.03; bank funds, $754.74; crockery, tables, etc., $308. Receipts in 1899, $5,832.12: bounty, $600; bank funds, $40.82; new members, $54; donations, $232; other sources, $4,905.30. Expenditures in 1899, $6,420.82: premiums and gratuities paid, $1,278.75; current running expenses, $3,999.19; other expenses, $1,142.88. The society offered about $1,500 in premiums, awarded $1,291.75 in premiums and gratuities and paid $1,278.75, which went to 23 cities and towns. Two hundred and twenty persons received premiums and gratuities. Under head of farm and pet stock $700.50 was awarded and paid; under farm and garden products $243.25 was awarded and paid; under dairy products $95 was awarded and paid; under domestic manu-

factures $77.75 was awarded and paid; under agricultural implements $16 was awarded and paid; under trotting $806 was paid; under objects other than agricultural, not specified, $83.75 was awarded and paid. The society reports 698 members, — 465 males and 233 females. Three farmers' institutes were held: at Lancaster, February 21, on "Plant food;" at Harvard, March 25, on "Fungoid diseases and their remedies" and "The home garden;" and at West Boylston, December 20, on "Good, better, best, methods of producing and selling milk."

WORCESTER NORTH-WEST AGRICULTURAL AND MECHANICAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 117.

Originally raised by contribution, $3,400; now has $12,600 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $12,705.39: real estate, $12,000; crockery, tables, etc., $600; cash on hand, $105.39. Total liabilities consist of mortgages or like liabilities to the amount of $3,600. Receipts in 1899, $4,014.92: bounty, $600; new members, $12.50; other sources, $3,402.42. Expenditures in 1899, $3,909.53: premiums paid, $1,935.64; current running expenses, $1,800.98; interest, $172.91. The society offered $2,501.25 in premiums, awarded $2,022.95 and paid $1,935.64, which went to 20 cities and towns. Three dollars and seventy-five cents went to 2 towns outside the State. One hundred and forty-three persons received premiums. Under head of farms $19 was awarded and $18 paid; under farm and pet stock $723.50 was awarded and $705.69 paid; under farm and garden products $99.50 was awarded and $98.50 paid; under dairy products $14 was awarded and paid; under domestic manufactures $35.45 was awarded and $32.45 paid; under agricultural implements $1 was awarded and paid; under trotting $1,058 was paid; under objects other than agricultural, not specified, $9.50 was awarded and $8 paid. The society reports 1,043 members, — 668 males and 375 females. Four farmers' institutes were held: at Athol, February 8, on "Why I like the farm" and "Poultry for profit;" at Petersham, February 18, on "A rotation of crops" and

"The new agriculture: or, a system of farming for success;" at Phillipston, February 25, on "Commercial fertilizers *v.* stable manure" and "The best sources of nitrogen for the farmer;" and at Gardner, April 18, on "Now or never" and "The new farmer."

WORCESTER SOUTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 278.

Originally raised by contribution, $3,127.40; now has $10,925 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $11,101.33: real estate, $10,600; crockery, tables, etc., $325; cash on hand, $176.33. Total liabilities, $2,227.25: premiums due and unpaid, $24.75; outstanding bills, $2.50; mortgages or like liabilities, $2,200. Receipts in 1899, $3,669.08: bounty, $600; new members, $31; donations, $2; other sources, $3,036.08. Expenditures in 1899, $3,373.61: premiums and gratuities paid, $1,735.79; current running expenses, $1,277.84; interest, $125; other expenses, $234.98. The society offered $2,138.75 in premiums, awarded $1,735.79 in premiums and gratuities and paid $1,711.04, which went to 24 cities and towns. Fifty dollars went to 1 city outside the State. One hundred and two persons received premiums and 43 gratuities. Under head of farms $40 was awarded and paid; under farm and pet stock $621 was awarded and paid; under farm and garden products $106.36 was awarded and paid; under dairy products $17 was awarded and paid; under domestic manufactures $52.85 was awarded and $50.15 paid; under agricultural implements $11 was awarded and paid; under trotting $865 was paid; under objects other than agricultural, not specified, $22.58 was awarded and paid. The society reports 1,676 members, — 834 males and 842 females. Four farmers' institutes were held: at Sturbridge, January 14, on "Running a small farm on a large scale;" at West Brookfield, February 18, on "Dairy farming" and "Commercial fertilizers *v.* farm manures;" at Southbridge, March 2, on "The doings of the Farmers' National Congress at Fort Worth, Tex.;" and at Brookfield, March 11, on "Roads and roadside improvements" and "The doings of the Farmers' National Congress at Fort Worth, Tex."

WORCESTER COUNTY WEST AGRICULTURAL SOCIETY.

Incorporated 1851, Acts of 1851, chapter 278.

Originally raised by contribution, $3,175 ; now has $13,600 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $14,234.96 : real estate, $12,600 ; crockery, tables, etc., $1,000 ; cash on hand, $634.96. Receipts in 1899, $3,666.77 : bounty, $600 ; new members, $42 ; donations, $43.58 ; other sources, $2,981.19. Expenditures in 1899, $3,251.55 : premiums and gratuities paid, $1,617.47 ; current running expenses, $1,207.08 ; interest, $27 ; note paid, $400. The society offered $1,867.50 in premiums, awarded $1,661.05 in premiums and gratuities and paid $1,617.47, which went to 29 cities and towns. Twelve dollars and twenty-five cents went to parties outside the State. One hundred and fifty-six persons received premiums and 50 gratuities. Under head of farms $31 was awarded and $28.50 paid ; under farm and pet stock $626 was awarded and $590.50 paid ; under farm and garden products $98.95 was awarded and $97.22 paid ; under dairy products $9 was awarded and $7.50 paid ; under domestic manufactures $46.35 was awarded and $44 paid ; under trotting $840 was paid ; under objects other than agricultural, not specified, $9.75 was awarded and paid. The society reports 494 members, — 436 males and 58 females. Three farmers' institutes were held : at Hubbardston, January 20, on "The practical management of a dairy farm ;" at Oakham, January 24, on "Apple culture for profit ;" and at Barre, February 3, on "Twenty years' experience in peach growing in Massachusetts."

Summary.

	1897.	1898.	1899.
Number of societies,	*36	†34	†34
Amount held invested or well secured as a capital stock.	$803,181 25	$798,922 16	$743,472 58
Assets of societies,	923,350 26	944,507 86	1,208,154 46
Liabilities of societies,	186,176 95	157,458 75	317,183 56
Receipts,	221,182 56	303,309 95	315,230 90
Expenditures,	218,335 95	158,521 16	185,893 27
Bounty received from State,	20,344 68	19,933 17	18,871 51
Current running expenses,	85,284 08	73,666 44	62,152 55
Amount of premiums offered,	79,503 80	68,377 80	62,410 55
Amount of premiums and gratuities awarded,	59,408 24	50,983 93	47,243 53
Amount of premiums and gratuities paid,	57,606 49	49,430 57	46,518 21
Amount awarded under head of farms,	1,137 50	1,420 50	1,067 00
Amount awarded under head of farm and pet stock.	20,764 68	17,855 00	16,217 00
Amount awarded under head of field and garden crops.	1,065 75	1,157 71	1,045 25
Amount awarded under head of farm and garden products.	13,475 86	12,021 08	12,232 64
Amount awarded under head of dairy products.	578 25	349 00	471 00
Amount awarded under head of domestic manufactures.	3,778 15	3,576 52	3,153 32
Amount awarded under head of miscellaneous.	3,710 21	3,703 77	2,879 38
Amount paid out for trotting,	24,893 42	19,365 75	16,456 50
Number of persons receiving premiums,	7,242	7,110	6,861
Number of persons receiving gratuities,	1,918	1,330	1,811
Total male membership of societies,	22,960	21,620	21,756
Total female membership of societies,	7,718	7,551	7,091
Total membership of the societies,	30,678	29,171	28,847
Number of farmers' institutes held,	125	118	115

* Two held no fair. † One held no fair.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN THE STATE.

MARCH, 1900.

State Board of Agriculture, 1900.

Members ex Officio.

His Excellency W. MURRAY CRANE.
His Honor JOHN L. BATES.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
JAMES W. STOCKWELL, *Secretary.*

Members appointed by the Governor and Council.

	Term Expires
DWIGHT A. HORTON of Northampton,	1901
WILLIAM R. SESSIONS of Springfield,	1902
FRANCIS H. APPLETON of Manchester,	1903

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1903
Barnstable County,	JOHN BURSLEY of West Barnstable,	1901
Berkshire,	WESLEY B. BARTON of Dalton,	1903
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1903
Bristol County,	EDWARD M. THURSTON of Swansea (P. O. South Swansea),	1902
Deerfield Valley,	HENRY A. HOWARD of Colrain,	1902
Eastern Hampden,	O. E. BRADWAY of Monson,	1903
Essex,	JOHN M. DANFORTH of Lynnfield (P.O. Lynnfield Centre),	1902
Franklin County,	F. L. WHITMORE of Sunderland,	1901
Hampshire,	GEO. P. SMITH of Sunderland,	1901
Hampshire, Franklin and Hampden,	H. C. COMINS of Hadley,	1903
Highland,	C. K. BREWSTER of Worthington,	1902
Hillside,	ALVAN BARRUS of Goshen (P.O. Lithia),	1902
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1903
Hoosac Valley,	GEO. P. CARPENTER of Williamstown (P. O. Blackinton),	1903
Housatonic,	CHARLES B. BENEDICT of Egremont,	1903
Man'f'trs' Agr'l (No. Attleborough),	OSCAR S. THAYER of Attleborough,	1903
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1903
Martha's Vineyard,	EVERETT A. DAVIS of West Tisbury,	1901
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1903
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1903
Middlesex North,	JOSHUA CLARK of Tewksbury (P. O. Lowell),	1901
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1902
Nantucket,	J. S. APPLETON of Nantucket,	1903
Oxford,	H. H. SIGOURNEY of Oxford,	1901
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1902
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1901
Union (Agr'l and Hort'l),	ALMON W. LLOYD of Blandford,	1901
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1903
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1902
Worcester East,	W. A. KILBOURN of South Lancaster,	1903
Worcester North-west (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P. O. Athol Centre),	1901
Worcester South,	C. D. RICHARDSON of West Brookfield,	1901
Worcester County West,	CHAS. A. GLEASON of New Braintree,	1902

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . . His Excellency W. MURRAY CRANE, *ex Officio*.
1st Vice-President, WILLIAM R. SESSIONS of Springfield.
2d Vice-President, . AUGUSTUS PRATT of North Middleborough.
Secretary, . . JAMES W. STOCKWELL of Sutton.
Office, Rooms 134–136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. Kilbourn of South Lancaster.
Isaac Damon of Wayland.
D. A. Horton of Northampton.
John Bursley of West Barnstable.
Edmund Hersey of Hingham.
Francis H. Appleton of Manchester.
Augustus Pratt of North Middleborough.
F. W. Sargent of Amesbury.

Committee on Agricultural Societies.

Messrs. W. A. Kilbourn of South Lancaster.
Q. L. Reed of South Weymouth.
Chas. A. Gleason of New Braintree.
Henry A. Howard of Colrain.
Geo. P. Carpenter of Williamstown.

Committee on Domestic Animals and Sanitation.

Messrs. Isaac Damon of Wayland.
Oscar S. Thayer of Attleborough.
Joshua Clark of Tewksbury.
F. L. Whitmore of Sunderland.
Almon W. Lloyd of Blandford.

Committee on Gypsy Moth, Insects and Birds.

Messrs. Augustus Pratt of North Middleborough.
F. W. Sargent of Amesbury.
J. M. Danforth of Lynnfield Centre.
John G. Avery of Spencer.
Wm. R. Sessions of Springfield.

Committee on Dairy Bureau and Agricultural Products.

Messrs. D. A. Horton of Northampton.
J. L. Ellsworth of Worcester.
C. D. Richardson of West Brookfield.
C. B. Benedict of Egremont.
H. H. Sigourney of Oxford.

Committee on Agricultural College and Education.

Messrs. John Bursley of West Barnstable.
C. K. Brewster of Worthington.
Wesley B. Barton of Dalton.
Geo. P. Smith of Sunderland.
Alvan Barrus of Goshen.

Committee on Experiments and Station Work.

Messrs. Edmund Hersey of Hingham.
T. H. Goodspeed of Athol.
N. I. Bowditch of Framingham.
S. B. Taft of Uxbridge.
Wm. H. Spooner of Boston.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. Francis H. Appleton of Manchester.
J. S. Appleton of Nantucket.
E. A. Davis of West Tisbury.
H. A. Turner of Norwell.
O. E. Bradway of Monson.

Committee on Institutes, Rules and Legislation.

Messrs. F. W. Sargent of Amesbury.
Edmund Hersey of Hingham.
Edward M. Thurston of Swansea.
W. B. Barton of Dalton.
Henry C. Comins of Hadley.

The secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. D. A. HORTON of Northampton, 1901; C. D. RICHARDSON of West Brookfield, 1901; J. LEWIS ELLSWORTH of Worcester, 1902.

SPECIALISTS.

By Election of the Board.

Chemist,	Dr. C. A. GOESSMANN,	Amherst.
Entomologist,	Prof. C. H. FERNALD,	Amherst.
Botanist and Pomologist,	Prof. S. T. MAYNARD,	Amherst.
Veterinarian,	Prof. JAMES B. PAIGE,	Amherst.
Engineer,	WM. WHEELER,	Concord.
Ornithologist,	E. H. FORBUSH,	Malden.

By Appointment of the Secretary.

Librarian, F. H. FOWLER, B.Sc., *First Clerk*.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

Board of Trustees.	Term expires
Nathaniel I. Bowditch of Framingham,	1901
William Wheeler of Concord,	1901
Elijah W. Wood of West Newton,	1902
Chas. A. Gleason of New Braintree,	1902
Samuel C. Damon of Lancaster,	1903
James Draper of Worcester,	1903
Henry S. Hyde of Springfield,	1904
Merritt I. Wheeler of Great Barrington,	1904
James S. Grinnell of Greenfield,	1905
Charles L. Flint of Brookline,	1905
William H. Bowker of Boston,	1906
J. D. W. French of North Andover,	1906
J. Howe Demond of Northampton,	1907
Elmer D. Howe of Marlborough,	1907

Members Ex Officio.

His Excellency Governor W. Murray Crane,
President of the Corporation.

Henry H. Goodell, M.A., LL.D., ... *President of the College.*
Frank A. Hill, ... *Secretary of the Board of Education.*
James W. Stockwell, ... *Secretary of the Board of Agriculture.*

Officers elected by the Board of Trustees.

James S. Grinnell of Greenfield, ... *Vice-President of the Corporation.*
James W. Stockwell of Sutton, ... *Secretary.*
Prof. Geo. F. Mills of Amherst, ... *Treasurer.*
Charles A. Gleason of New Braintree, ... *Auditor.*

Board of Overseers.

The State Board of Agriculture.

Examining Committee of the Board of Agriculture.

Messrs. Bursley, Brewster, Barton, Smith and Barrus.

Hatch Experiment Station of the Massachusetts Agricultural College.

Henry H. Goodell, M.A., LL.D., ... *Director.*
William P. Brooks, B.Sc., ... *Agriculturist.*
Samuel T. Maynard, B.Sc., ... *Horticulturist.*
Charles H. Fernald, Ph.D., ... *Entomologist.*
Henry T. Fernald, Ph.D., ... *Associate Entomologist.*
Chas. A. Goessmann, Ph.D., LL.D., ... *Chemist* (Fertilizers).
Joseph B. Lindsey, Ph.D., ... *Chemist* (Foods and Feeding).
George E. Stone, Ph.D., ... *Botanist.*
J. E. Ostrander, C.E., ... *Meteorologist.*

Board of Cattle Commissioners.	Term expires
Austin Peters, M.R.C.V.S., of Boston, *Chairman*,	1902
L. F. Herrick of Millbury, *Secretary*,	1901
Charles A. Dennen of Pepperell,	1900

Office, Commonwealth Building, Boston.

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF THE LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,*	J. J. Mason, Amesbury.	A. H. Fielden, Amesbury.	J. E. Brierly, Amesbury.
Barnstable County,	C. M. Hinkle, Barnstable.	T. C. Day, Barnstable.	A. F. Sherman, Barnstable.
Berkshire,	M. W. Coleman, Richmond.	Chas. H. Wright, Pittsfield.	Wm. P. Wood, Pittsfield.
Blackstone Valley,	Edward J. Prest, Uxbridge.	Edwin F. Tuttle, Uxbridge.	L. A. Seagrave, Uxbridge.
Bristol County,	Edward H. Temple, Taunton.	Gertrude Williams, Taunton.	E. C. Holt, Taunton.
Deerfield Valley,	Wm. O. Long, Shelburne.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden,	A. D. Norcross, Monson.	F. D. Barton, Palmer.	F. D. Barton, Palmer.
Essex,	Geo. von L. Meyer, Hamilton.	J. M. Danforth, Lynnfield Centre.	G. L. Streeter, Salem.
Franklin County,	John S. Anderson, Shelburne.	Henry J. Field, Greenfield.	Henry J. Field, Greenfield.
Hampshire,	A. M. Lyman, Montague.	Thos. R. Hill, Amherst.	Thos. R. Hill, Amherst.
Hampshire, Franklin and Hampden,	J. F. Burt, Easthampton.	S. S. Warner, Northampton.	D. J. Wright, Northampton.
Highland,	Wesley B. Barton, Dalton.	John T. Bryan, Middlefield.	M. J. Smith, Middlefield.
Hillside,	R. M. Porter, Cummington.	W. G. Atkins, West Cummington.	D. E. Lyman, Cummington.
Hingham,*	E. L. Ripley, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,	F. D. Stafford, North Adams.	George H. Kearn, North Adams.	M. R. Ford, North Adams.
Housatonic,	E. L. Van Deusen, Sheffield.	Frank H. Briggs, Great Barrington.	O. C. Bidwell, Great Barrington.
Manufacturers' Agricultural,	S. O. Bigney, Attleborough.	Wm. H. Pond, Attleborough.	W. W. Sherman, North Attleborough.
Marshfield,*	H. A. Oakman, Marshfield.	Francis Collamore, North Pembroke.	Francis Collamore, North Pembroke.
Martha's Vineyard,	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural,	Francis H. Appleton, Manchester.	Robert Manning, Boston.	C. E. Richardson, Cambridge.
Massachusetts Society for Promoting Agriculture,	Chas. S. Sargent, Brookline.	Francis H. Appleton, Manchester.	R. M. Saltonstall, Newton.
Middlesex North,	H. S. Perham, Chelmsford.	Geo. B. Coburn, Lowell.	S. Drewett, Lowell.
Middlesex South,	S. O. Staples, South Framingham.	Geo. E. Harrington, South Framingham.	S. B. Bird, South Framingham.
Nantucket,	Joseph A. Johnson, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.

* And horticultural.

AGRICULTURAL SOCIETIES, ETC. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Oxford,	John J. Allen, Auburn.	H. H. Sigourney, Oxford.	H. H. Sigourney, Oxford.
Plymouth County,	Augustus Pratt, North Middleborough.	Geo. M. Hooper, Bridgewater.	Geo. M. Hooper, Bridgewater.
Spencer (Farmers' and Mechanics' Association),	E. H. Howland, Spencer.	H. H. Capen, Spencer.	H. H. Capen, Spencer.
Union,*	H. K. Herrick, Blandford.	E. W. Boise, Blandford.	A. H. Nye, Blandford.
Weymouth (Ag'l and Ind.),	E. B. Nevin, South Weymouth.	T. L. Tirrell, South Weymouth.	Gordon Willis, South Weymouth.
Worcester,	Wm. J. Hogg, Worcester.	Wm. J. Wheeler, Worcester.	Wm. J. Wheeler, Worcester.
Worcester East,	John E. Thayer, Lancaster.	W. A. Kilbourn, South Lancaster.	Lucius Field, Clinton.
Worcester Northwest (Agricultural and Mechanical),	Jonas R. Davis, Gardner.	Albert Ellsworth, Athol.	F. G. Amsden, Athol.
Worcester South,	Walter B. Mellen, Brookfield.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	A. F. Adams, Barre Plains.	Matthew Walker, Barre.	Chas. H. Follansby, Barre.

* And horticultural.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann,	Gloucester,	Bennett Griffith, Gloucester.	William D. Lufkin, Gloucester.
Haverhill,	Haverhill,	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Haverhill.
Hampden County,	Springfield,	Jacob C. Lutz, Springfield.	William F. Gale, Springfield.
Houghton,	Lynn,	Walter B. Allen, Lynn.	Miss Ruth S. Wood, Lynn.
Lenox,	Lenox,	Henry P. Wokey, Stockbridge.	Charles R. Russell, Stockbridge.
Massachusetts,	The State,	Francis H. Appleton, Manchester.	Robert Manning, Boston.
Newton,	Newton,	L. H. Farlow, Newton.	L. H. Farlow, Newton.
Springfield Amateur,	Springfield,	W. T. Hutchin, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County,	Worcester County,	O. B. Hadwen, Worcester.	Adin A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	Henry J. Haynes, Bolton.	Wm. M. Brigham, Bolton.
Leominster,	Leominster,	George M. Kendall, Leominster.	C. C. Foster, Leominster.
Middlesex and Worcester,	Hudson,	Oliver Sawyer, Hudson.	Josiah S. Welsh, Hudson.
Needham,	Needham,	Eben Higgins, Dover.	Cyrus W. Jones, Needham.
Oakham,	Oakham,	Henry A. Crawford, Oakham.	Wm. S. Crawford, Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	A. B. Holden, Westminster.	Judson Foster, South Westminster.

Farmers' and Mechanics' Clubs.

Ashburnham,	Ashburnham,	E. J. Foristall, South Ashburnham.	Walter E. Jefts, Ashburnham.
Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	Geo. H. B. Green, Belchertown.
Groton,	Groton,	T. Lawrence Motley, Groton.	Charles Woolley, Groton.
Holden,	Holden,	Benjamin M. Chamberlain, Holden.	Reuben H. Moore, Holden.
Pepperell,	Pepperell,	A. N. Blood, Pepperell.	S. R. Merrill, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.
West Acton,	West Acton,	Isaac Reed, West Acton.	Chas. B. Stone, West Acton.
Wilmington,	Wilmington,	Chas. J. Sargent, Wilmington.	Edw. M. Nichols, Wilmington.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Ashfield,	Ashfield,	John M. Sears, Ashfield.	A. G. Howes, Ashfield.
Boxborough,	Boxborough,	Frank A. Patch, West Acton.	J. F. Hayward, West Littleton.
Buckland,	Buckland,	Baxter A. Orcutt, Buckland.	Eli C. Maynard, Buckland.
Chamberlain District,	Worcester,	Wm. J. Wheeler, Worcester.	Pliny Moore, Worcester.
East Charlemont,	East Charlemont,	L. H. Richmond, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	Monroe Morse, Medway.	L. W. Daniels, Franklin.
Halifax,	Halifax,	Jabez P. Thompson, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Huntington,	Huntington,	C. H. Strong, Norwich.	H. W. Stickney, Norwich.
Lancaster,	Lancaster,	Geo. F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	Luther Crawford, New Braintree.	W. W. Merrill, North Brookfield.
New Salem,	New Salem,	D. F. Carpenter, Millington.	Willard Putnam, Cooleyville.
Rehoboth,	Rehoboth,	Dr. C. H. Raymond, Rehoboth.	C. W. Goff, South Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Royalston,	Royalston,	– –	G. E. Pierce, Royalston.
Rutland,	Rutland,	Wm. C. Temple, Rutland.	Mrs. W. G. Wales, Rutland.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Allen Russell, Jr., Acushnet.
Sterling,	Sterling,	Joseph H. Kilburn, Sterling.	Ezra Sawyer, Sterling.
Tatnuck,	Worcester,	Elliott Moore, Worcester.	H. Ward Moore, Worcester.
Upton,	Upton,	Geo. S. Ball, Upton.	F. T. Nelson, Upton.
West Brookfield,	West Brookfield,	A. C. White, West Brookfield.	L. H. Chamberlain, West Brookfield.
West Newbury,	West Newbury,	Dr. A. H. Pierce, West Newbury.	A. L. Moore, West Newbury.
West Peabody,	West Peabody,	Mrs. F. C. Durkee, West Peabody.	Bertha G. Small, West Peabody.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	Henry M. Bliss, Wilbraham.

Miscellaneous.

Agricultural Library Association,	Swansea,	S. G. Arnold, Swansea Village.	A. E. Arnold, Swansea Centre.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	J. Howell Crosby, Arlington.
Bristol Co. Fruit Growers' Association,	Dighton,	J. E. Sears, Dighton.	Wm. P. Eddy, Dighton.
Bay State Agricultural Society,	The State,	J. D. W. French, Boston.	N. I. Bowditch, Framingham.
Brockton Agricultural Society,	Brockton,	Henry W. Robinson, Brockton.	Baalis Sanford, Brockton.
Burlington Agricultural Society,	Burlington,	Fernald E. Ham, Lexington.	Samuel Sewall, Burlington.
Cranberry Growers' Association,	Cape Cod District,	Emulous Small, Harwichport.	Franklin Crocker, Hyannis.
Farmers' and Gardeners' Club,	Hanson,	George F. Simpson, Hanson.	F. S. Thomas, M.D., Hanson.
Franklin Harvest Club,	Connecticut Valley,	Dr. J. B. Learned, Florence.	C. B. Lyman, Southampton.
Hampden Agricultural Society,	Springfield,	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	W. H. Porter, Agawam.
Massachusetts Creamery Association,	The State,	C. M. Bull, Springfield.	A. W. Morse, Belchertown.
Massachusetts Forestry Association,	The State,	Dr. Henry P. Walcott, Cambridge.	Allen Chamberlain, Winchester.
Massachusetts Fruit Growers' Association,	The State,	W. O. Mead, Lunenburg.	C. A. Whitney, Upton.
Middlesex East Agricultural Association,	Wakefield,	Frank P. Bennett, Saugus.	Charles Talbot, Montrose.
Westborough Agricultural Society,	Westborough,	John B. Fitch, Westborough.	George M. Howe, Westborough.
Worcester North Agricultural Society,	Fitchburg,	J. L. Harrington, Lunenburg.	John H. White, Fitchburg.
Young People's Agricultural Club,	Wilbraham,	George Chapin, Hampden.	J. W. Rice, Wilbraham.

MASSACHUSETTS PATRONS OF HUSBANDRY.

Officers of the State Grange, 1900.

Master,	Warren C. Jewett of Worcester.
Overseer,	E. A. Emerson of Haverhill.
Lecturer,	George S. Ladd of Sturbridge.
Steward,	W. B. Barton of Dalton.
Assistant Steward,	J. B. Parkin of Holliston.
Chaplain,	Rev. C. S. Walker of Amherst.
Treasurer,	F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	I. H. Lamb of Stoughton.
Pomona,	Mrs. Carrie C. Sabin of Amherst.
Flora,	Mrs. Emma E. Eaton of Fitchburg.
Ceres,	Mrs. Daisy Shaw Merritt of Westford.
Lady Assistant Steward,	Mrs. S. Ella Southland of Athol.

Executive Committee.

C. A. Dennen,	Pepperell.
Geo. L. Clemence,	Southbridge.
Elmer D. Howe,	Marlborough.

Deputies.

Marcellus Boynton,	Shawmut.
T. E. Flarity,	Townsend.
Herbert Sabin,	Amherst.
F. H. Stevens,	West Acton.
C. D. Richardson,	West Brookfield.
Charles G. Hinckley,	Lee.
Edward A. Fuller,	North Andover.
I. N. Day,	South Hadley.
John E. Gifford,	Sutton.
C. A. Stimson,	Royalston.
J. E. Goodell,	West Boylston.
Charles H. Rice,	Leominster.
H. F. Maxwell,	Canton.
Rev. A. H. Wheelock,	Millis.
Geo. E. Crosby,	Tewksbury.
E. E. Chapman,	Indian Orchard.

Special Deputies.

Wm. N. Howard,	South Easton.
F. H. Plumb,	Springfield.
Geo. W. Roraback,	Westfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	H. E. Hosmer, Millis.	Abel F. Stevens, Wellesley.	Nellie S. Stevens, Wellesley.
Essex County, No. 2,	Charles L. Bailey, Andover.	Peter Holt, Jr., North Andover.	Matilda B. Lund, West Boxford.
Middlesex and Worcester, No. 3,	Charles F. Watts, Littleton Common.	S. R. Walker, Leominster.	Mrs. Daisy S. Merritt, Coldspring.
Franklin and Worcester, No. 4,	James F. Whitcomb, Athol Centre.	M. D. Herrick, North Orange.	L. E. Stewart, Athol.
Worcester West, No. 5,	Charles W. Whitney, Ashburnham.	Hamlin A. Whitney, South Gardner.	Charles W. Snow, Nichewaug.
Berkshire County, No. 6,	Alonzo Bradley, Lee.	J. S. Cole, Hinsdale.	Blanche W. Barton, Dalton.
Worcester Central, No. 7,	Fred J. Reed, Shrewsbury.	Adin A. Hixon, Worcester.	Mrs. Ellen M. Hayward, Millbury.
Hampshire County, No. 8,	W. A. Mann, Northampton.	C. A. Judd, South Hadley.	Miss Alice F. Dickinson, Amherst.
Worcester Southwest, No. 9,	F. A. Putnam, Dudley.	Mrs. Mary Olds Lakin, Brookfield.	Mrs. A. J. Thompson, Brookfield.
Worcester and Norfolk, No. 10,	William P. Greenwood, South Milford.	Mrs. Wm. P. Greenwood, South Milford.	A. W. Gaskill, Mendon.
Borough, No. 11,	E. N. Stratton, Marlborough.	Mrs. Mary C. Graham, Westborough.	Mrs. Mary S. Wood, Northborough.
Springfield, No. 12,	Arthur Sikes, Mapleton, Conn.	F. G. Bennett, Ludlow.	Mrs. Carrie L. Hayward, Agawam.
Old Colony, No. 13,	Ernest H. Gilbert, Stoughton.	Mrs. E. V. Carpenter, Attleborough.	Mrs. G. W. Stevens, South Braintree.
Worcester East, No. 14,	George M. Stuart, Sterling.	Louis A. Stuart, Sterling.	Mrs. E. T. Cunningham, Lancaster.
Quabaug, No. 15,	William E. Patrick, Warren.	Windsor R. Smith, West Brookfield.	Andrew A. Brigham, Brookfield.
Subordinate Granges.			
Northfield, No. 3,	T. R. Callender, Northfield.	Mrs. L. G. Morgan, Northfield.	H. H. Mason, Northfield.
Groton, No. 7,	Francis M. Boutwell, Groton.	George L. Smith, Groton.	Myron P. Swallow, Groton.
Barre, No. 9,	Geo. N. Harwood, Barre.	Mrs. Lizzie Patterson, Barre.	T. P. Blakeley, Barre.
"Hope" of Hadley, No. 15,	Leslie R. Smith, Hadley.	Mrs. H. E. Smith, Hadley.	Mrs. C. L. Hartwell, South Amherst.
Amherst, No. 16,	D. R. Whipple, Amherst.	Miss Cora B. Church, South Amherst.	Miss Alice F. Dickinson, Amherst.
Hinsdale, No. 19,	Thomas F. Barker, Hinsdale.	Frank F. Watkins, Hinsdale.	John S. Cole, Hinsdale.
Westfield, No. 20,	B. H. Ellis, Westfield.	Mrs. William Arnold, Westfield.	Annette Sackett, Westfield.
Worcester, No. 22,	W. K. Stanley, Worcester.	H. Ward Moore, Worcester.	Mrs. Adelle E. Grout, Worcester.
Dalton, No. 23,	George N. Brown, Pittsfield.	Mrs. C. H. C. Woodworth, Dalton.	Wesley B. Barton, Dalton.
Blandford, No. 24,	C. W. Bates, Blandford.	George M. Emmons, Russell.	John E. Perkins, Blandford.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Easthampton, No. 27,	W. M. Gaylord, Easthampton.	Mrs. A. L. Pettis, Easthampton.	Frank R. Carter, Easthampton.
Montgomery, No. 45,	L. O. Moore, Montgomery.	Mrs. J. E. Camp, Montgomery.	Miss Agnes E. Moore, Montgomery.
Southwick, No. 46,	Amasa Holcomb, Southwick.	Monroe G. Spring, Southwick.	Mrs. N. J. French, Southwick.
"Highland" of Huntington, No. 48,	Hartley R. Gooch, Huntington.	Mrs. W. A. Mason, Huntington.	Mrs. Bertha M. Kelso, Huntington.
Worthington, No. 49,	George T. Dodge, Ringville.	Rev. George Moody, South Worthington.	Mrs. E. M. Cole, West Chesterfield.
Sterling, No. 53,	Elmer E. Peeso, Pratt's Junction.	Mrs. Jennie C. Peeso, Pratt's Junction.	Fred R. Trask, Sterling.
Springfield, No. 54,	D. E. Carpenter, Springfield.	H. C. Woodward, Springfield.	H. C. Rich, Springfield.
Auburn, No. 60,	George M. Allen, Worcester.	M. L. Hervey, Auburn.	J. H. Prouty, Auburn.
"Union" of Belchertown, No. 64,	E. A. Randall, Belchertown.	George P. Jackson, Belchertown.	Mrs. D. P. Spencer, Belchertown.
Brimfield, No. 65,	George H. Streeter, Brimfield.	Mrs. O. E. Parker, Brimfield.	Mrs. Everett Sherman, Brimfield.
Hardwick, No. 67,	Charles H. Prouty, Furnace.	John N. Hillman, Hardwick.	F. E. Ruggles, Gilbertville.
Phillipston, No. 70,	C. Waldo Bates, Phillipston.	Mrs. L. M. Goddard, Phillipston.	D. W. Baker, Phillipston.
"Prescott" of Pepperell, No. 73,	Edmund S. Blood, Pepperell.	Mrs. Lizzie E. Starr, Pepperell.	Miss Florence E. Kemp, Pepperell.
Holden, No. 78,	C. B. Jordan, Holden.	Mrs. Harrison Lovell, Holden.	Mrs. Clarence Stanhope, Holden.
Spencer, No. 79,	Edson C. Bemis, Spencer.	Mrs. Florence M. Upham, Spencer.	J. W. Bigelow, Spencer.
"Manhan" of Southampton, No. 82,	Charles S. Hooker, Holyoke.	J. S. Frary, Southampton.	Mrs. C. P. Gridley, Southampton.
North Orange, No. 86,	Merrill D. Herrick, North Orange.	Mrs. Ellen M. Conant, North Orange.	Mrs. Martha A. Cheney, North Orange.
Lee, No. 88,	Charles H. Shaylor, Lee.	Anson Buck, Stockbridge.	Charles O. Swift, Lee.
Charlton, No. 92,	George R. Taylor, Charlton.	Edward M. Bowers, Charlton Depot.	Albert R. Jones, Charlton.
Grafton, No. 93,	J. Frank Johnson, North Grafton.	John H. Chapin, Grafton.	Edward S. Clark, Jr., Grafton.
Petersham, No. 95,	S. B. Cook, Petersham.	Miss Mabel A. Cook, Petersham.	Mrs. F. M. Spooner, Petersham.
Shrewsbury, No. 101,	Fred. J. Reed, Shrewsbury.	Mrs. Jeanette Stone, Shrewsbury.	Mrs. Anne S. Rice, Shrewsbury.
Stow, No. 103,	Charles W. Crandall, Stow.	Miss Emma Brown, Stow.	Mrs. U. M. Lewis, Stow.
"Garfield" of No. Dana, No. 104,	J. E. Doubleday, North Dana.	Lyman Randall, North Dana.	Mrs. W. T. Childs, North Dana.
Marlborough, No. 105,	Joseph Walker, Marlborough.	Elmer D. Howe, Marlborough.	Mrs. E. N. Stratton, Marlborough.
West Boylston, No. 106,	Charles A. Bolton, West Boylston.	William Parker, West Boylston.	Frederick B. Walker, West Boylston.
Millbury, No. 107,	George I. Stowe, West Millbury.	Miss Mabel R. Searles, Millbury.	Miss Addie L. Carter, Millbury.

Hudson, No. 108,	L. W. Bruce, Hudson.	Ellen A. Lamson, Hudson.	Mrs. Mary E. Lawrence, Hudson.
Sutton, No. 109,	R. H. Richardson, Sutton.	John E. Gifford, Sutton.	Miss Sarah M. Mills, Sutton.
Sherborn, No. 110,	Chas. O. Littlefield, South Framingham.	George L. Whitney, South Framingham.	Mrs. Geo. L. Whitney, So. Framingham.
Boylston, No. 111,	Wm. H. Warren, Boylston Centre.	Nathaniel L. Kendal, Boylston Centre.	Mrs. H. M. Andrews, Boylston Centre.
"East Medway" of Millis, No. 112,	Wesley W. Whiting, Millis.	Willard P. Clark, Rockville.	Fred H. Holland, Jr., Millis.
Framingham, No. 113,	Luther Marston, Framingham.	Mrs. Grace Adams, Framingham.	Mrs. Lila F. Warren, Framingham.
Medfield, No. 114,	J. Herbert Baker, Medfield.	Simon E. Stone, Medfield.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115,	Miss Mary E. Cutler, Holliston.	Mrs. Carrie A. Pond, Holliston.	Henry Leland, Holliston.
Westborough, No. 116,	Charles Jones, Southville.	Mrs. F. P. Rogers, Westborough.	Mrs. Ella C. B. Leonard, Westborough.
Dover, No. 117,	Carl M. Koopman, Dover.	Miss Eva Chamberlain, Dedham.	Mrs. Sarah A. Higgins, Dover.
Southborough, No. 118,	P. S. Lincoln, Southville.	Mrs. C. I. Newton, Southborough.	Mrs. Mary A. Klebes, Southborough.
Northborough, No. 119,	E. H. Bemis, Northborough.	Mrs. Mary L. Richardson, Northborough.	Mrs. Elsie J. Mills, Northborough.
Lancaster, No. 120,	Wm. A. Kilbourn, South Lancaster.	Mrs. R. M. Farnsworth, Lancaster.	Mrs. H. Eliza Currier, Clinton.
Sudbury, No. 121,	J. S. Rice, North Sudbury.	Miss Ida E. Goodnow, South Sudbury.	H. Arthur Bowker, North Sudbury.
Templeton, No. 122,	G. E. Stiles, Baldwinsville.	G. E. French, Gardner.	Mrs. Rachel S. Titterton, Templeton.
Oxford, No. 123,	L. H. Cudworth, Oxford.	Miss Alice M. Brady, Oxford.	G. E. Kimball, Oxford.
Ashland, No. 124,	C. P. Rockwood, Ashland.	Mrs. H. D. Stone, Ashland.	Miss Bertha Stone, Ashland.
Upton, No. 125,	S. L. Madden, Milford.	Mrs. Gertrude Aldrich, West Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	A. C. Murdock, Hubbardston.	Miss Ida A. Bennett, Hubbardston.	George E. Morse, Hubbardston.
Amesbury, No. 127,	Willis F. Austin, Amesbury.	J. Augustus Davis, Amesbury.	Miss Nellie A. Huntington, Amesbury.
North Andover, No. 128,	Harry C. Foster, North Andover.	Albert Currier, North Andover Depot.	W. H. Hayes, North Andover.
Gardner, No. 130,	Herbert F. Smith, South Gardner.	Mrs. Mary A. Stone, Gardner.	Miss Alice E. Munroe, West Gardner.
Boxborough, No. 131,	Levi W. Perkins, West Acton.	Mrs. L. C. Hager, West Acton.	C. T. Wetherbee, West Acton.
North Brookfield, No. 132,	Herbert E. Cummings, North Brookfield.	Mrs. H. E. Cummings, North Brookfield.	Miss Minnie McCarthy, North Brookfield.
Berlin, No. 134,	Edwin E. Wheeler, Berlin.	Mrs. Frank P. Buston, Berlin.	Mrs. Fannie A. Jones, South Berlin.
Norfolk, No. 135,	Arthur D. Towne, City Mills.	George P. Holbrook, Norfolk.	Mrs. Sarah B. Sims, Norfolk.
East Blackstone, No. 137,	O. Fermor Fuller, Blackstone.	Mrs. Adelaide E. Stearns, Blackstone.	Adrian Scott, Woonsocket, R. I.
Northampton, No. 138,	John McQuestion, Hadley.	Clayton S. Parsons, Northampton.	Miss Sarah E. Mason, Northampton.
East Sandwich, No. 139,	S. F. Crocker, Marston's Mills.	Mrs. J. R. Holway, East Sandwich.	George Parker, East Sandwich.
West Boxford, No. 140,	George B. Austin, West Boxford.	Charles F. Austin, West Boxford.	Miss Matilda B. Lund, West Boxford.
Montague, No. 141,	C. M. Hemenway, North Leverett.	Mrs. Laura A. King, Montague.	F. A. Rist, Montague.
Bolton, No. 142,	Herbert B. Sawyer, Bolton.	Mrs. Clara S. Wolcott, Bolton.	Mrs. Dorcas H. Babcock, Bolton.
Mendon, No. 143,	Moses U. Gaskill, Mendon.	Leonard E. Taft, Mendon.	Albert W. Gaskill, Mendon.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Franklin, No. 144,	Norman B. Stone, Franklin.	Mrs. John L. Fisher, City Mills.	Miss Julia W. Allen, Franklin.
Douglas, No. 145,	Frederic A. Place, East Douglas.	S. E. Brown, East Douglas.	E. T. Rawson, East Douglas.
West Newbury, No. 146,	J. W. McDonald, West Newbury.	Mrs. Elizabeth M. Newell, W. Newbury.	Mrs. Annie Swap, West Newbury.
West Springfield, No. 147,	Homer B. Miller, West Springfield.	Miss Effie L. Smith, Mitteneague.	Mrs. Helen L. Phelps, West Springfield.
Swansea, No. 148,	Frank L. Gardner, South Swansea.	Etta L. Gardner, Swansea Centre.	Wm. M. Sherman, Swansea Centre.
Harvard, No. 149,	Stowell W. Davis, Harvard.	Charles L. Clay, Harvard.	Henry L. Knight, Harvard.
Concord, No. 150,	T. M. Barry, Concord.	Mrs. B. Mea Nealey, Concord.	H. C. Ingerson, Concord.
Agawam, No. 151,	John G. Burt, Agawam.	Mrs. F. C. Learned, Agawam.	Mrs. C. L. Hayward, Agawam.
East Longmeadow, No. 152,	Alpheus Peck, East Longmeadow.	John L. Davis, East Longmeadow.	E. L. Endicott, East Longmeadow.
Wilbraham, No. 153,	Mrs. E. C. Clark, Wilbraham.	Mrs. C. C. Beebee, Wilbraham.	Mrs. D. L. Bosworth, Wilbraham.
Haverhill, No. 154,	Jackson Haynes, Haverhill.	Dr. Philip C. Means, Haverhill.	Miss Elmina C. Gordon, Haverhill.
Methuen, No. 155,	Samuel Emerson, Methuen.	J. E. Buswell, Lawrence.	Mrs. Mary A. Crosby, Methuen.
West Bridgewater, No. 156,	L. Augustus Tower, Westdale.	Eddy P. Dunbar, West Bridgewater.	Howard B. Wilbur, West Bridgewater.
Granby, No. 157,	George A. Blish, Granby.	Mrs. Geo. F. Bell, Granby.	George F. Bell, Granby.
"Nemasket" of Middleborough, No. 158,	J. H. Cushing, Middleborough.	Mrs. B. C. Shaw, Middleborough.	Mrs. Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159,	Arthur G. Galusha, Williamstown.	Mrs. William Crozier, Williamstown.	Mrs. Geo. G. Walker, Williamstown.
South Hadley, No. 160,	Mrs. E. S. Johnson, Northampton.	H. E. Brainerd, South Hadley Falls.	Gertrude E. Brainerd, South Hadley Falls.
"Laurel" of West Newbury, No. 161,	John F. Hibbs, West Newbury.	Mrs. Alice H. Stultz, West Newbury.	Preston C. Rogers, Newburyport.
Dartmouth, No. 162,	John O. Slocum, Dartmouth.	Mrs. Hannah A. Briggs, So. Dartmouth.	J. H. Slocum, Dartmouth.
Dudley, No. 163,	George B. Truell, Dudley.	Miss Sally C. Healy, Dudley.	Dyer S. Elliott, Dudley.
Ware, No. 164,	George Lamberton, Ware.	Daniel J. Quirk, Ware.	Charles O. Buffington, Ware.
Hampden, No. 165,	Mrs. G. T. Ballard, Hampden.	Mrs. L. A. Burleigh, Hampden.	Rev. James B. Sargent, Hampden.
Wellesley, No. 166,	G. N. Smith, Newton Lower Falls.	Mrs. Ella C. Lyon, Wellesley Hills.	Mrs. Chas. Cartwright, Wellesley.
Somerset, No. 168,	Walter L. Calder, Fall River.	Augusta A. Wood, Pottersville.	Miss L. A. Davis, Pottersville.
Lunenburg, No. 169,	John Wooldredge, Lunenburg.	James L. Harrington, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170,	Fred H. Snow, Furnace.	Miss Mabel F. Snow, Furnace.	Mrs. Kittie C. Pollard, North Brookfield.

Merrimac, No. 171,	Arthur P. Odway, Merrimac.	Miss Nellie M. Barry, Merrimac.	John J. Woodman, Merrimac.
Ashby, No. 172,	W. H. C. Lawrence, Ashby.	M. W. Jefts, Ashby.	Mrs. A. A. Damon, Ashby.
Hopkinton, No. 173,	Henry H. Loring, Hopkinton.	Mrs. Abbie E. Gowell, Hopkinton.	Mrs. S. Mabel Thompson, Hopkinton.
Brookfield, No. 174,	Robert S. Hyde, West Brookfield.	Abbie Thompson, Brookfield.	Sabra S. King, Brookfield.
Athol, No. 175,	Dr. James Oliver, Athol Centre.	Mrs. Sarah L. Smith, Athol Centre.	Mrs. Mercie S. Doane, Athol.
"Miller's River" of Orange, No. 176,	L. H. Jerome, Orange.	Mrs. L. H. Jerome, Orange.	Mrs. Nettie M. Lindsey, Orange.
Sturbridge, No. 177,	Mrs. George Ladd, Sturbridge.	Arthur P. Plimpton, Globe Village.	Allen E. Shepard, Globe Village.
Monson, No. 178,	O. E. Bradway, Monson.	F. D. Rogers, Monson.	Omar Pease, Monson.
Ludlow, No. 179,	E. E. Chapman, Indian Orchard.	Miss Mary E. Clark, Ludlow Centre.	Mrs. Lizzie C. Chapman, Indian Orchard.
West Brookfield, No. 180,	Dr. W. R. Smith, West Brookfield.	Mrs. E. K. Haskins, West Brookfield.	Mrs. Philander Holmes, W. Brookfield.
Westport, No. 181,	C. R. Macomber, Central Village.	Eldores E. Weston, Central Village.	Jas. H. Sullivan, Central Village.
Southbridge, No. 182,	Wm. H. Eccleston, Southbridge.	Miss May L. Stebbins, Southbridge.	Miss Adella Hare, Southbridge.
Andover, No. 183,	S. H. Bailey, Andover.	Mrs. E. W. Boutwell, Lowell.	R. A. Watson, Andover.
Topsfield, No. 184,	Wellington Donaldson, Topsfield.	A. T. Merrill, Topsfield.	Mrs. Lillie Donaldson, Topsfield.
"Milton" of North Attleborough, No. 185,	Daniel B. Hunt, Oldtown.	Miss Fanny Everett, Abbot Run, R. I.	Miss Ruth E. Hunt, Oldtown.
Fitchburg, No. 186,	George W. Taylor, Fitchburg.	Mrs. Sarah E. Haskins, Fitchburg.	Herbert L. Hill, Fitchburg.
"Satuit" of Norwell, No. 187,	Nathan S. Turner, Norwell.	Fred J. Croning, Norwell.	Mrs. Margaret M. Sexton, Norwell.
Littleton, No. 188,	Herbert O. Wing, Littleton.	Mrs. Nellie F. Johnson, Littleton.	Mrs. Mary R. Davidson, Littleton Common.
Warren, No. 189,	Albert B. Patrick, Warren.	Alfred A. Warriner, Warren.	Mrs. Jennie M. Williams, Warren.
Bellingham, No. 190,	Carroll E. White, Bellingham.	Mrs. C. E. White, Bellingham.	John J. O'Sullivan, Bellingham.
"Chestnut Hill" of Blackstone, No. 191,	W. O. Burden, Blackstone.	Miss Ruth L. Southwick, Mendon.	Mrs. Eleanor R. Tiffany, Millville.
Winchendon, No. 192,	Clarence A. Brooks, Winchendon.	John Gregory, Winchendon.	Henry J. Whittemore, Winchendon.
Foxborough, No. 193,	Louis W. Hodges, Foxborough.	Frank N. Davis, Foxborough.	Miss Adella O. Drake, Foxborough.
Townsend, No. 194,	G. A. Proctor, Townsend Harbor.	Mrs. Abbie A. Barber, Townsend.	G. A. Wilder, Townsend.
Royalston, No. 195,	L. G. Forbes, Royalston.	Mrs. C. H. Wilcox, Royalston.	Mrs. Nellie M. Smith, Royalston.
Easton, No. 196,	Willis P. Holbrook, North Easton.	Mrs. V. S. Marshall, North Easton.	Mrs. Emily M. Drew, North Easton.
"Brookville" of Holbrook, No. 197,	J. Capen Howard, Brockton.	Aurelia M. Howard, Brockton.	E. A. G. Hambly, Brookville.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Leominster, No. 198,	W. J. Nutting, North Leominster.	Miss Grace M. Putnam, Leominster.	Jas. E. Coleman, North Leominster.
Stoughtòn, No. 199,	H. F. Maxwell, Canton.	Mrs. R. Gertrude Paul, Stoughton.	E. H. Gilbert, Stoughton.
Uxbridge, No. 200,	Jas. A. Pierce, Whitinsville.	Mrs. G. Z. Taft, Uxbridge.	Mrs. C. B. Davis, Millville.
Bridgewater, No. 201,	Ernest Leach. Bridgewater.	Mrs. Minnie S. Swift, Bridgewater.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202,	Albert Needham, Ashburnham.	Mrs. Mary C. Watkins, Ashburnham.	Mrs. Ella C. Needham, Ashburnham.
Westminster, No. 203,	John Minott, South Gardner.	Mrs. Alice W. Sterling, Westminster.	Mrs. Nellie Waterhouse, Westminster.
Rowley, No. 204,	Frank E. Jackson, Rowley.	J. Scott Todd, Rowley.	Charles A. Houghton, Rowley.
"Webster" of Marshfield, No. 205,	Miss G. M. Damon, North Marshfield.	E. L. Willard, Marshfield Hills.	Mrs. A. L. Carver, Marshfield Hills.
Hanover, No. 206,	Joshua Studley, West Hanover.	Mrs. Jennie B. Simmons, N. Pembroke.	Mrs. Hattie I. West, North Pembroke.
Tewksbury, No. 207,	C. E. Clark, Tewksbury Centre.	H. M. Billings, Tewksbury Centre.	Miss Susie C. Whittemore, Tewksbury Centre.
Westford, No. 208,	Walter J. Merritt, Coldspring.	S. L. Taylor, Coldspring.	Mrs. L. W. Wheeler, Westford.
Hanson, No. 209,	Chester W. Kiley, Hanson.	Mrs. Mary S. Damon, Hanson.	Miss Francella E. Bowker, Hanson.
Shawmut, No. 210,	James Whitaker, Shawmut.	Marcellus Boynton, Shawmut.	C. B. Phillips, Shawmut.
Chicopee, No. 211,	Edmund R. Macomber, Chicopee Falls.	Mrs. Edna S. Herrick, Chicopee.	Mrs. L. M. Billings, Chicopee.
"Oak Hill" of Attleborough, No. 212,	Henry A. Lord, Attleborough.	Dr. George Mackie, Attleborough.	Mrs. Lottie M. Worrall, Attleborough.
Walpole, No. 214,	Edward L. Shepard, Walpole.	Frank O. Pillsbury, Walpole.	Miss Edith R. Ellis, Walpole.
Mattaposett, No. 215,	Frank B. Tuttle, Mattapoisett.	Mrs. Alice Ashley, Mattapoisett.	Mrs. Cora M. Denham, Mattapoisett.
Dracut, No. 216,	Norman L. Peavey, Lowell.	Mrs. Calvin Richardson, Lowell.	Arthur W. Colburn, Dracut.
Mansfield, No. 217,	Oliver P. Cook, Mansfield.	John C. Collins, Mansfield.	G. E. Leonard, Mansfield.
Norton, No. 218,	Jacob A. Leonard, Norton.	George E. Smith, East Norton.	Charles T. Oldfield, Norton.
East Princeton, No. 219,	William S. French, East Princeton.	Alfred O. Tyler, East Princeton.	Mrs. E. A. Temple, East Princeton.
Sunderland, No. 220,	Dr. R. H. Clark, Sunderland.	Mrs. F. O. Williams, Sunderland.	Chester Warner, Sunderland.
"Anawan" of Rehoboth, No. 221,	Henry T. Horton, Rehoboth.	Mrs. Amelia A. Carpenter, Rehoboth.	Miss Elmie G. Goff, Rehoboth.
Tyngsborough, No. 222,	Lucian C. McLoon, Lowell.	Mrs. Charles A. Sherburne, Tyngsboro'.	Charles H. Danforth, Tyngsborough.
Billerica, No. 223,	A. H. Andrews, Billerica.	George P. Greenwood, Billerica.	Edward B. Haskell, Billerica.

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PUBLIC DOCUMENT . . . . No. 33.

TWELFTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1900.

BOSTON:
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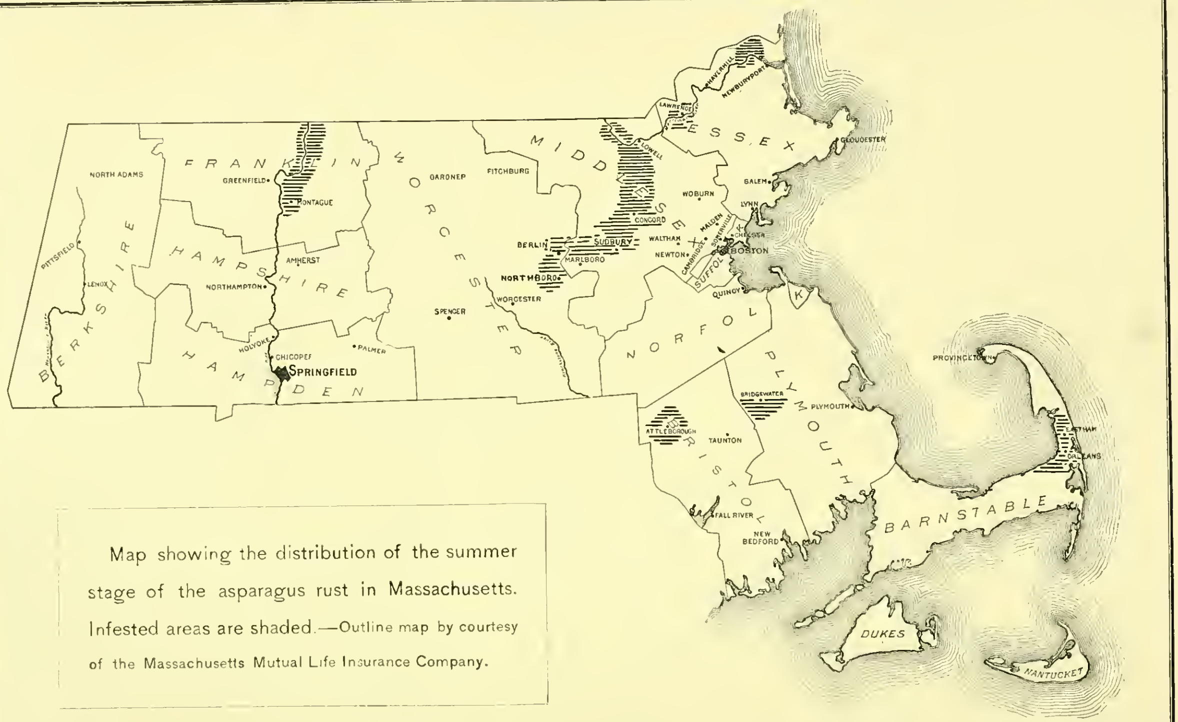

Map showing the distribution of the summer stage of the asparagus rust in Massachusetts. Infested areas are shaded.—Outline map by courtesy of the Massachusetts Mutual Life Insurance Company.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

By act of the General Court, the Hatch Experiment Station and the State Experiment Station have been consolidated under the name of the Hatch Experiment Station of the Massachusetts Agricultural College. Several new divisions have been created and the scope of others has been enlarged. To the horticultural has been added the duty of testing varieties of vegetables and seeds. The chemical has been divided, and a new division, "Foods and Feeding," has been established. The botanical, including plant physiology and disease, has been restored after temporary suspension.

The officers are : —

Henry H. Goodell, LL.D.,	*Director.*
William P. Brooks, Ph.D.,	*Agriculturist.*
George E. Stone, Ph.D.,	*Botanist.*
Charles A. Goessmann, Ph.D., LL.D.,	*Chemist* (fertilizers).
Joseph B. Lindsey, Ph.D.,	*Chemist* (foods and feeding).
Charles H. Fernald, Ph.D.,	*Entomologist.*
Henry T. Fernald, Ph.D.,	*Associate Entomologist.*
Samuel T. Maynard, B.Sc.,	*Horticulturist.*
J. E. Ostrander, C.E.,	*Meteorologist.*
Henry M. Thomson, B.Sc.,	*Assistant Agriculturist.*
Ralph E. Smith, B.Sc.,	*Assistant Botanist.*
Henri D. Haskins, B.Sc.,	*Assistant Chemist* (fertilizers).
Charles I. Goessmann, B.Sc.,	*Assistant Chemist* (fertilizers).
Samuel W. Wiley, B.Sc.,	*Assistant Chemist* (fertilizers).
Edward B. Holland, M.Sc.,	*First Chemist* (foods and feeding).
Fred W. Mossman, B.Sc.,	*Assistant Chemist* (foods and feeding).
Benjamin K. Jones, B.Sc.,	*Assistant Chemist* (foods and feeding).
Philip H. Smith, B.Sc.,	*Assistant in Foods and Feeding.*
George A. Drew, B.Sc.,	*Assistant Horticulturist.*
Herbert D. Hemenway, B.Sc.,	*Assistant Horticulturist.*
Arthur C. Monahan,	*Observer.*

The co-operation and assistance of farmers, fruit growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

The following bulletins are still in stock and can be furnished on demand: —

No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 37. Report on fruits, insecticides and fungicides.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 43. Effects of electricity on germination of seeds.
No. 45. Commercial fertilizers; fertilizer analyses; fertilizer laws.
No. 46. Habits, food and economic value of the American toad.
No. 47. Field experiments with tobacco.
No. 48. Fertilizer analyses.
No. 49. Fertilizer analyses.
No. 52. Variety tests of fruits; spraying calendar.
No. 54. Fertilizer analyses.
No. 55. Nematode worms.
No. 57. Fertilizer analyses.
No. 58. Manurial requirements of crops.
No. 59. Fertilizer analyses.
No. 60. Insecticides; fungicides; spraying calendar.
No. 61. The asparagus rust in Massachusetts.
No. 63. Fertilizer analyses.
Special bulletin, — The brown-tail moth.
Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.
Index, 1888–95.

Of the other bulletins, a few copies remain, which can be supplied only to complete sets for libraries.

The usual variety of problems have presented themselves for solution. In the agricultural division some interesting data have been collected on the use of sulfate and muriate of potash as fertilizers. With the sugar beet the larger yield was secured from the muriate, but the percentage of sugar was greater and the juice was of a higher degree of

purity, presenting less difficulties in manufacture, from the sulfate. In sweet and field corn there was no perceptible difference in product, quality or food value, but with cabbages the yield was much greater from the use of the sulfate. In the tests of potatoes the Beauty of Hebron and Early Rose still rank in 94 varieties among the most productive sorts, either for early or late harvests. In feeding poultry a narrow *v.* a wide ration for egg-production, the results seemed to be largely in favor of the wide ration, richer in corn meal and corn, in the following particulars: (*a*) lower cost of feed, (*b*) a gain of 23 to 91 per cent. more eggs, (*c*) a lower cost per egg, (*d*) a greater increase in weight and (*e*) a much earlier moult.

In the meteorological division, besides the usual observation of weather phenomena, the means of the various weather elements for the last ten years have been tabulated, and normal conditions for the period deduced. Observations relating to soil temperature and moisture by electrical methods have been continued, and results from the corn-growing season of the current year have been worked out to serve as basis for comparison in succeeding years.

In the horticultural division, experiments have been carried on in the use of hydrocyanic acid gas under glass as an insecticide, but definite results have not yet been secured.

In the entomological division, the card catalogue to the literature of North American insects now numbers over forty thousand. The inspection of nurseries for the San José scale and the granting of authorized certificates has been added to the work of the division; bulletins on the coccid genera Chionaspis and Hemichionaspis and the grass thrips have been issued, and one on the clover-head beetle and a monograph of the Pyralidæ are ready for publication. The composition of Raupenleim, formerly imported at a high price, has been determined, and it can now be made at a trifling cost.

In the botanical division, interesting observations have been made on the distribution of the asparagus rust in Massachusetts and the relation existing between its outbreaks and the rainfall, together with the physical properties of the soil. There is a marked susceptibility of plants

to this disease when grown in soil possessing little water-retaining properties, and a strong relation appears to exist between dry seasons and the occurrence of the summer or injurious stage of the rust.

The chemical division (foods and feeding) has analyzed during the year 2,045 substances, besides carrying on for the Association of Official Agricultural Chemists investigations relative to the best methods for the determination of starch, pentosans and galactan in agricultural products.

The chemical division (fertilizers) has issued 67 licenses to manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals, 38 of whom had offices of general distribution in Massachusetts; 384 samples of fertilizers were collected in the open markets by experienced assistants of the station, and 362 were analyzed and the results published in bulletins.

Reports from the different divisions, giving in detail the work of the year, accompany this brief summary.

ANNUAL REPORT.

Of George F. Mills, *Treasurer* of the Hatch Experiment Station of Massachusetts Agricultural College,

For the Year ending June 30, 1899.

Cash received from United States treasurer,		$15,000 00
Cash paid for salaries,	$4,216 31	
for labor,	5,167 16	
for publications,	1,090 45	
for postage and stationery,	242 31	
for freight and express,	122 39	
for heat, light and water,	164 77	
for chemical supplies,	3 45	
for seeds, plants and sundry supplies,	484 58	
for fertilizers,	1,076 40	
for feeding stuffs,	208 55	
for library,	411 65	
for tools, implements and machinery,	718 80	
for furniture and fixtures,	61 45	
for scientific apparatus,	201 90	
for live stock,	95 00	
for traveling expenses,	105 21	
for contingent expenses,	139 25	
for building and repairs,	490 37	
		$15,000 00
Cash received from State treasurer,	$11,200 00	
from fertilizer fees,	3,585 00	
from farm products,	1,641 78	
from miscellaneous sources,	1,906 71	
		$18,333 49
Cash paid for salaries,	$8,127 13	
for labor,	4,275 48	
for publications,	204 00	
for postage and stationery,	211 49	
for freight and express,	162 01	
for heat, light and water,	583 59	
Amount carried forward,	$13,563 70	

Amount brought forward, . . .	$13,563 70	
Cash paid for chemical supplies, ...	842 90	
for seeds, plants and sundry supplies, .	752 76	
for fertilizers, ...	302 21	
for feeding stuffs, ...	443 36	
for library, ...	33 97	
for tools, implements and machinery, .	32 75	
for furniture and fixtures, ...	227 68	
for scientific apparatus, ...	108 27	
for live stock, ...	87 22	
for traveling expenses, ...	272 70	
for contingent expenses, ...	180 00	
for building and repairs, ...	1,485 97	
		$18,333 49

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ending June 30, 1899; that I have found the books well kept and the accounts correctly classified as above; and that the receipts for the year are shown to be $33,333.49, and the corresponding disbursements $33,333.49. All the proper vouchers are on file, and have by me been examined and found to be correct, there being no balance on accounts of the fiscal year ending June 30, 1899.

CHARLES A. GLEASON,
Auditor.

AMHERST, Aug. 11, 1899.

REPORT OF THE AGRICULTURIST.

WM. P. BROOKS; ASSISTANT, H. M. THOMSON.

The work of the agricultural department of the station has been more extensive during the past year than ever before during its history. Besides the investigations selected for full discussion later in this report, we have carried on a large number of other out-door experiments, among which may be mentioned those having the following objects in view: with potatoes, to determine the best distance for planting; with oats, to determine relative value of equal money's worth of five different phosphates; with corn, to determine relative value of ten leading phosphates when used in quantities furnishing equal amounts of phosphoric acid; with orchard trees, to test the effects of five different systems of manuring; to test the value of employing nitragin for several of the crops of the clover family; to determine the adaptation and value of different grasses, forage and food crops.

We have put up a glass house for use in connection with pot experiments, and have installed a very complete equipment of iron tracks, trucks, pots, etc., for use in such experiments. The house is 23 by 60 feet, and contains six tracks. The track yard adjoining, which is enclosed by fine wire netting, is 28 by 80 feet. It contains seven tracks, on which the trucks carrying the pots stand during good weather, being quickly run into the house in case of rain or storm. It has transfer track, turn-table and an iron water tank. We have partitioned off a room (12 by 30 feet) in the old barn, cemented the floor, and connected the same with the glass house by iron track about 100 feet in length.

This serves as a work room in connection with pot experiments. We have this year carried on experiments with potatoes, onions, soy beans, corn and millet as crops, in which we have used 286 pots. The results are of much value, having assisted toward the solution of a number of important problems; but, as there remains much chemical work to be finished in connection therewith, these experiments cannot be reported at this time. Of the value of this method of experiment, which has so approved itself with European investigators, there can not be the slightest doubt; it will prove a most important adjunct to field work.

We have further carried out a number of experiments in cylinders 4 feet deep and 2 feet in diameter (without bottom), plunged to the rim in the open air and filled with equal amounts of carefully mixed earth. In these experiments we have employed sixty-three such cylinders, dealing with some important problems. This too proves a valuable method of work. Results are not yet sufficiently worked out for publication.

The report will touch in detail only upon experiments the results of which are sufficiently definite to permit practical deductions of value. The report on such experiments follows.

Soil Tests.

Two soil tests have been carried out upon our home grounds during the past season, both in continuation of previous work upon the same ground. The same kinds of fertilizers have been applied to each plot and in the same amounts as last year. In addition, each plot in the first test received an application of slaked lime, at the rate of one ton per acre; in the second test, one-half of each plot received an application of lime at the same rate. The lime was spread evenly early this spring, and harrowed in, both fields having been ploughed the previous fall.

Soil Test with Corn. Amherst.

The past is the eleventh season that the experiment on this field has been in progress. The crops in order of rotation

have been corn, corn, oats, grass and clover, grass and clover, corn followed by mustard as a catch-crop, rye, soy beans, white mustard, corn, and this year corn once more. During all this time four of the fourteen plots into which the field is divided have received neither manure nor fertilizer; three having but a single important manurial element, nitrogen, phosphoric acid and potash, — every year the same; three have received each year two of these elements; one has received all three yearly; and one each has received yearly lime, plaster and farm-yard manure. It will be seen that the greater part of the field has remained either entirely unmanured or has had but a partial manuring, and it will be readily understood that the degree of exhaustion of most of the plots is considerable. The nothing plots produced this year an average of 4.6 bushels of shelled corn per acre and 767.5 pounds stover; and even this figure is somewhat misrepresentative, owing to the fact that after this long period two of the nothing plots which adjoin plots which have been yearly well manured begin to feel the effect of the high fertility of their neighbors, although separated from them by strips three and one-half feet wide.

The Effect of the Fertilizers.

The table shows clearly the marked differences undoubtedly due to the variation now eleven years continued in the fertilizer treatment. The fertilizers wherever employed are applied at the following rates per acre; nitrate of soda, 160 pounds (furnishing nitrogen); dissolved bone-black, 320 pounds (furnishing phosphoric acid); muriate of potash, 160 pounds (furnishing potash); land plaster, 160 pounds; lime, 160 pounds; and cow manure, 5 cords. All plots, it must be remembered, received also an application of lime at the rate of 1 ton per acre, in addition to the materials named in the table.

*South Acre Soil Test, 1899.**

Plot.	FERTILIZERS.	Yield per Acre.		Gain or Loss compared with Nothing Plots, per Acre.	
		Shelled Corn † (Bushels).	Stover † (Pounds).	Shelled Corn (Bushels).	Stover (Pounds).
1	Nitrate of soda,	13.75	1,160	9.87	430
2	Dissolved bone-black,	3.50	620	—.38	—110
3	Nothing,	3.88	730	-	-
4	Muriate of potash,	49.75	2,760	45.50	2,000
5	Lime,	7.25	1,100	2.62	310
6	Nothing,	5.00	820	-	-
7	Manure,	75.88	5,350	70.88	4,530
8	Nitrate of soda and dissolved bone-black.	21.38	1,220	15.50	380
9	Nothing,	5.88	840	-	-
10	Nitrate of soda and muriate of potash.	47.88	2,360	42.75	1,573
11	Dissolved bone-black and muriate of potash.	59.88	3,160	55.50	2,427
12	Nothing,	3.63	680	-	-
13	Plaster,	6.63	990	3.00	310
14	Nitrate of soda, dissolved bone-black and muriate of potash.	72.88	4,450	69.25	3,770

* All plots limed at rate of one ton per acre.

† Both stover and ears were driest upon the plots giving the larger yields, viz., 4, 7, 10, 11 and 12, for only on these was growth sufficiently normal to allow natural ripening.

The Results in 1898.

[No lime had been used except on the lime plot.]

For purposes of comparison I here present a statement covering the results of last year (1898), when also the crop, as has been pointed out, was corn. I quote from my last annual report: —

The single-element plots, one receiving nitrate of soda only yearly, another phosphoric acid and the third potash, give this year practically equal crops of grain, respectively at the rate of 20.6, 18.5 and 19.8 bushels per acre. The nitrate of soda and dissolved bone-black give a crop at the rate of 32 bushels per acre, while nitrate of soda and potash give at the rate of but 10.9 bushels. The dissolved bone-black and muriate of potash do much better, yielding at the rate of 41.2 bushels. The fertilizer supplying nitrogen, phosphoric acid and potash gives a crop of 55.9 bushels, while manure gives 67.7 bushels.

It may be remembered that in each of the three previous years in which this field has produced corn the muriate of potash has, whether singly or in combination, proved much more useful than either of the other fertilizers used. There is much evidence in the behavior of the crops this year, during the growing season, and in the results, that this salt is proving injurious in its chemical effect upon the soil. I believe this effect to be a loss of lime in the form of chloride by leaching, but cannot regard this as yet proven. I will present the facts apparently bearing upon the case, and leave full discussion to a later report.

1. During the early part of the growing season the corn upon all the plots which had received muriate of potash was distinctly behind that upon other plots.

2. As the season advanced, the corn upon these plots gradually lost its sickly appearance, gained upon that in the other plots, eventually excelling, in the case of the plot receiving nitrogen, phosphoric acid and potash, that in all other plots except the manure plot.

3. This unhealthy appearance of the corn early in the season, followed by great improvement later, is analogous to effects noticed in other experiments,* where chlorides have been used, and where liming the land has remedied the faulty condition.

4. On that plot receiving dissolved bone-black as well as muriate of potash, the crop was in the end a good one. As is well known, the dissolved bone-black contains a large amount of sulfate of lime. It is believed that this may take the place of the lime leached from the soil as a consequence of the use of muriate of potash, or at least that it corrects in some way the faulty condition consequent upon the use of this salt. It may here be pointed out that a similar corrective influence is evident in the results obtained both in 1897 and 1898 upon our other soil test acre, which will immediately be discussed.

It is of interest, further, to point out that the crop this year upon the lime plot was not quite equal to the average of the nothing plots, while that of the plaster plot (sulfate of lime) was about double that of the lime plot. In the earlier years of this soil test the yield of neither the lime nor the plaster plot ever exceeded that of the nothings, but for the past three years the plaster plot has been relatively gaining. The explanation of this difference between the effect of plaster and lime is not apparent. It will be made the subject of future study. . . .

The problems suggested by the results of the year must be

* For example, Plot 6, Field A. See report State Experiment Station for 1896.

regarded as the most valuable product of this experiment. These problems are not solved. Their solution will throw important light upon methods to be employed in compounding and selecting fertilizers.

Conclusions (based upon Results in 1899).

1. By reference now to the table showing the yields for 1899, it will be seen that what last year was merely a suspicion, supported, it is true, by incidental observations in connection with other experiments, is apparently confirmed by the results of this year after liming, viz.: *that last year the application of potash failed to prove beneficial as in the earlier years when corn was grown, because its continued use in the form of muriate had resulted in depleting the soil of its lime.*

It should be noticed that I say "*apparently* confirmed." I would point out that the results of this experiment by themselves do not furnish absolute proof, for its plan is such that it does not enable us to decide that the superior results of the past season may not have been due to the fact that the lime proved beneficial through indirect effects which might have been exerted equally well by some other alkali, such as an alkaline salt of soda or of magnesia. To determine this point, two series of pot experiments with soil from two plots in this field have been carried out. In these, besides slaked lime, we have employed land plaster (sulfate of lime), carbonate and sulfate of magnesia, and bicarbonate and sulfate of soda. The results are not fully worked up, but they decisively indicate: (*a*) *That the benefit from the use of lime was not due to the fact that it corrected soil acidity.* (Sulfate of lime, a neutral salt, produced a better growth than slaked lime, while neither the carbonate of magnesia nor the carbonate of soda proved distinctly beneficial; the latter, indeed, was highly injurious.) (*b*) That it was not due to indirect action of any other sort. (Substances exercising similar chemical and physical influence upon the soil did not prove equally beneficial with the plaster or the slaked lime.)

2. The yield of each of the plots which has been manured with muriate of potash is largely increased. Alone and in

every combination it proves highly beneficial. *That this soil after eleven years' continuous application of muriate of potash at the rate of 160 pounds per acre annually should be capable after liming of producing corn at the rate of 49.75 bushels of shelled grain per acre, is astonishing.*

3. The crop, amounting to almost 60 bushels shelled corn per acre, on the plot which now for eleven years has yearly received only dissolved bone-black and muriate of potash (lime this year of course excepted) and which in this long period of time has received no addition of nitrogen in the form of manure or fertilizers, illustrates the remarkable extent to which, in our climate, the corn plant can thrive upon the natural stores of this element in the soil and that which it accumulates as a result of the introduction of clover into the rotation.

4. It will be noticed that where the elements nitrogen, phosphoric acid and potash have been yearly supplied, the crop this year, amounting to about 73 bushels per acre, is within three bushels of that produced where manure at the rate of 5 cords per acre has been annually applied. The fertilizers used (nitrate of soda, 160 pounds; dissolved bone-black, 320 pounds; and muriate of potash, 160 pounds per acre) cost about $10; while the manure, if purchased, would cost $25 at least in most parts of the State. It should be pointed out, however, that this soil has almost perfect physical characteristics. On the one hand, its perfect drainage insures freedom from excessive moisture even in wet seasons; and, on the other, the happy mean existing in the proportion of fine and coarse particles insures good water-conducting power (capillarity), and thus prevents injury from drought and injurious crust formation. In such a soil the organic matter furnished by manure is far less necessary than in those which are either more sandy or more clayey. For these reasons, fertilizers have doubtless made a more favorable showing as compared with manure than would usually be the case. The table shows the relative standing of the two plots, 7 (manure) and 14 (complete fertilizer), for the entire period of eleven years. It will be seen that the financial outcome where the fertilizer has been used is much better than for the plot receiving manure.

Increases as compared with Plot receiving no Manure.

Produced by Complete Fertilizer, 1889–99.

CROP.	Number Years grown.	Bushels.	Pounds.	Value of Increase.	Cost of Fertilizers.
Corn, ...	5	198.05	stover, 12,475	$107 29	$48 00
Oats, ...	1	15.63	straw, 1,720	14 70	9 60
Rye, ...	1	15.36	straw, 2,480	12 10	9 60
Soy beans, ...	1	–	beans, 880; straw, 840	4 61	9 60
Grass, ...	2	–	hay, 3,420; rowen, 1,360	37 56	19 20
Mustard, ...	1	–	5,100	–	19 20*
				$176 20	$115 20

Produced by Manure, 1889–99.

CROP.	Number Years grown.	Bushels.	Pounds.	Value of Increase.	Cost of Fertilizers.
Corn, ...	5	216.08	stover, 13,990	$117 79	$125 00
Oats, ...	1	18.13	straw, 3,260	22 11	25 00
Rye, ...	1	21.07	straw, 3,200	31 84	25 00
Soy beans, ...	1	–	beans, 1,520; straw, 3,880	77 26	25 00
Grass, ...	2	–	hay, 4,860; rowen, 3,460	64 27	50 00
Mustard, ...	1	–	8,500	–	50 00*
				$313 27	$300 00

* Double application of fertilizers and manure for mustard.

Soil Test with Onions. Amherst.

This experiment occupied a field which has been employed in work of this kind for ten years, the several plots having been every year manured alike, as described under the "Soil test with corn." The previous crops in the order of rotation have been: potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and ruta-baga turnips, potatoes and onions. The land was ploughed in the fall of 1898 and reploughed early this past spring. Fertilizers were employed this year in the same quantities as last, viz., nitrate of soda at the rate of 320 pounds; dissolved bone-black, 640 pounds; and muriate of potash, 320 pounds, per acre. These fertilizers are each used upon one plot singly, in pairs, and upon one plot all three together. The west half of each plot was limed, as has been stated, at the rate of 1 ton per acre.

The seed was sown in the customary manner, but more thickly, on April 28. Germination was prompt and perfect.

The development upon the several plots and upon the unlimed and limed sections of all the plots exhibited the most remarkable differences.

1. Many of the plants upon the nothing plots soon died, and those remaining made practically no growth. The limed halves of these plots throughout the first half of the season were even worse in these respects than the unlimed.

2. The application of no single element without lime gave a good growth; but the plants upon the dissolved bone-black (without lime) did best. With lime the growth was more feeble than without it on the dissolved bone-black plot. On the plot on which muriate of potash was used without lime most of the plants soon died, while on this fertilizer alone and lime there was a rank growth, though few ripe bulbs were harvested. Nitrate of soda with lime gave better growth than without, but both with and without growth was very feeble.

3. On nitrate of soda and muriate of potash without lime almost all plants died; with lime there was a rank growth; but the bulbs did not ripen well.

4. On nitrate of soda and dissolved bone-black without lime was the best growth on the unlimed portion of the field. As last year, the development upon these two fertilizers alone was much better than on the plot where they were employed in the same amounts with muriate of potash. The growth upon the limed portion of the plot receiving the nitrate and bone-black was not materially improved, while where the muriate of potash was used with these fertilizers liming influenced the growth most favorably.

5. Liming proved highly favorable on the plot where dissolved bone-black and muriate of potash were used, this portion of that plot ranking third in the field in appearance throughout the season, while there was little growth upon the unlimed portion.

The Effect of the Fertilizers.

The tables give the results of the harvest : —

North Acre Soil Test, Onions, 1899.

Plots.	MANURING.	RESULTS IN POUNDS, INCLUDING TOPS. Yield per acre. Unlimed.	Yield per acre. Limed.	Gain or loss compared with nothings, per acre. Unlimed.	Gain or loss compared with nothings, per acre. Limed.
Plot 1,	Nothing, ...	2,950	3,180	-	-
Plot 2,	Nitrate of soda, ...	4,470	9,700	356.67	5,046.67
Plot 3,	Dissolved bone-black, . .	2,950	2,570	—2,323.33	—2,836.67
Plot 4,	Nothing, ...	6,440	6,520	-	-
Plot 5,	Muriate of potash, . . .	3,270	24,740	—2,510	18,467.50
Plot 6,	Nitrate of soda and dissolved bone-black.	17,410	17,380	12,290	11,355
Plot 7,	Nitrate of soda and muriate of potash.	1,440	25,030	—3,020	19,252.50
Plot 8,	Nothing, ...	3,800	5,530	-	-
Plot 9,	Dissolved bone-black and muriate of potash.	11,090	19,510	7,680	13,815
Plot 10,	Nitrate of soda, dissolved bone-black and muriate of potash.	13,770	22,730	10,750	16,870
Plot 11,	Plaster, ...	1,550	1,610	—1,080	—4,415
Plot 12,	Nothing, ...	2,240	6,190	-	-

North Acre Soil Test, Onions, 1899.

Plots.	MANURING.	RESULTS IN BUSHELS OF 52 POUNDS OF FAIRLY CURED ONIONS. Yield per Acre. Unlimed.	Yield per Acre. Limed.	Gain or loss compared with nothings, per acre. Unlimed.	Gain or loss compared with nothings, per acre. Limed.
Plot 1,	Nothing, ...	2.69	4.42	-	-
Plot 2,	Nitrate of soda, ...	18.65	91.43	15.13	79.77
Plot 3,	Dissolved bone-black, . .	6.53	12.31	2.17	—6.60
Plot 4,	Nothing, ...	5.19	26.15	-	-
Plot 5,	Muriate of potash, . . .	3.07	161.75	—1.54	137.90
Plot 6,	Nitrate of soda and dissolved bone-black.	143.10	200.00	139.06	178.46
Plot 7,	Nitrate of soda and muriate of potash.	3.07	145.40	—.39	121.55
Plot 8,	Nothing, ...	2.88	16.93	-	-
Plot 9,	Dissolved bone-black and muriate of potash.	40.38	183.88	37.21	163.50
Plot 10,	Nitrate of soda, dissolved bone black and muriate of potash.	46.15	224.60	42.69	200.94
Plot 11,	Plaster, ...	4.04	6.35	.29	—20.68
Plot 12,	Nothing, ...	4.04	30.39	-	-

The Results and Conclusions based thereon in 1898.

In 1898 also the crop upon this field was onions, and it is desirable to present the leading statements and conclusions published that year for the purpose of comparison. The manuring was the same as this year, save that no lime was used. I quote from my last annual report: —

The results show that this [phosphoric acid, — dissolved bone-black] more than either the nitrogen or the potash supply controlled the product. The crop was very light, however, even upon the best plot, which was at the rate of 116.9 bushels per acre, upon the plot receiving nitrate of soda and dissolved bone-black. Upon the plots receiving these two fertilizers and muriate of potash the crop amounted to only 16.3 bushels per acre. Here is strong evidence that the muriate of potash has produced in the soil of this field conditions absolutely prejudicial to the growth of the onion.

Last year this field was in potatoes under the same system of manuring, but with half the quantities employed this year. The crop of potatoes on the nitrate and bone-black was much heavier than on these two and potash, and in commenting upon this fact in my annual report I wrote: "The apparent superiority of the phosphoric acid and nitrogen is chiefly due to the fact that the plot to which these two elements alone were applied was for some reason (not believed to be the effect of the fertilizer alone) nearly twice as great as that upon any other plot. Had the crop where the potash was added to the nitrogen and phosphoric acid been better or even as good as that where the phosphoric acid and nitrogen alone were used, we should be justified in the conclusion that nitrogen and phosphoric acid are the elements chiefly required. The crop where all three elements were combined was, however, much inferior to that where the nitrogen and phosphoric acid were used without potash. We must, therefore, conclude that some disturbing factor, at present unknown, influenced the results."

In view of the similar relative results upon the two plots under discussion this year, I am now forced to conclude that I was mistaken last year in supposing that the superiority of the plot receiving nitrogen and phosphoric acid only was not "the effect of the fertilizer alone."

I now believe that the muriate of potash has proved actually injurious to the last two crops, and that the explanation (the loss of lime which it causes) already suggested accounts for this effect.

Conclusions (based upon Results in 1899).

1. A study of the tables giving the results of this year affords convincing presumptive evidence that the continued use of muriate of potash has so depleted this soil of lime that its use for the onion crop is a necessity. The suspicion of last year, just quoted, is apparently confirmed. The results obtained in two series of pot experiments (not yet fully worked up), in which soil from two plots in this field was used, force me, however, to look upon this conclusion as in a measure tentative; for in the pot experiments other alkalies proved almost, if not quite, as beneficial as lime, indicating that the presence of free acid in the soil may have been the cause of the poor growth upon most of the plots of this field. Even this conclusion cannot, however, be looked upon as final, for the substitution of sulfate for the muriate of potash in the pots resulted in good growth without the addition of any alkali. A full discussion of the subject is reserved for some future article.

2. We are meanwhile justified in the statement that both field and pot experiments show that the muriate is an undesirable form in which to apply potash for this crop, though the bad influence of the chlorine which it contains may possibly be neutralized by application of lime.*

3. The remarks of last year may in conclusion be appropriately quoted: —

The Proper Course as regards Potash Supply.

What, then, in view of our results, are we to recommend? Clearly not to cease using potash, — we have been unable to raise good crops without it. It is believed the remedy will be found in one of three directions, viz., (1) the occasional liberal use of lime where muriate of potash is employed; (2) the use of other potash salts, such as carbonate or sulfate; or (3) the employment of wood ashes as a source of potash. Should potash be supplied in the form of either carbonate or sulfate, lime leaches from the soil much less rapidly; the same is true of ashes, and these, moreover, sup-

* It is believed that the influence of the lime will be even more marked another year. It was applied, it will be remembered, this spring. Its action, as was anticipated, was not sufficiently prompt to prevent much injury to the onions, because of faulty soil conditions in the early part of the season. We have accordingly failed to produce a good yield on any plot this year.

ply much lime. This entire question, however, demands further experimental study, and I am not at present prepared to give definite advice upon this point.

Manure Alone v. Manure and Potash.

An experiment in continued corn culture for the comparison of an average application of manure with a smaller application of manure used in connection with muriate of potash was begun in 1890. A full account will be found in the annual reports of 1890–96, and in 1895 a general summary of the results up to that date was given.

The land used in this experiment was seeded with a mixture of timothy, red-top and clover in the standing corn of 1896. A good stand of grass and clover was secured, although the latter was rather unevenly developed in different parts of the field, suggesting a possible lack of thoroughness in mixing the seeds.

No manure or potash was used in 1897. The field was kept in grass two years, and was manured as usual in 1898. It includes four plots, of one-fourth an acre each. The average results while in grass are shown below : —

Plots 1 and 3 (manure alone, 6 cords per acre, 1890–96) : per acre, hay, 5,662 pounds ; rowen, 3,218 pounds.

Plots 2 and 4 (manure, 3 cords per acre, 1890–92 ; 4 cords, 1893–96 ; and potash, 160 pounds per acre) : per acre, hay, 4,540 pounds ; rowen, 2,633 pounds.

The sod was turned in the autumn of 1898 and was manured this spring, as shown below : —

Plot 1, manure, 1½ cord ; weight, 8,825 pounds.

Plot 2, { manure, 1 cord ; weight, 5,880 pounds.
high-grade sulfate of potash, 40 pounds.

Plot 3, manure, 1½ cord ; weight, 8,840 pounds.

Plot 4, { manure, 1 cord ; weight, 5,880 pounds.
high-grade sulfate of potash, 40 pounds.

The crop this year has been corn (Sibley's Pride of the North), and its development appears to have been normal in all respects. The crop was a heavy one on all plots.

Yield per Plot.

PLOTS.	Ears (Pounds).	Stover (Pounds).
Plot 1,	1,331	1,260
Plot 2,	1,331	1,160
Plot 3,	1,341	1,170
Plot 4,	1,355	1,110

Average Yield per Acre.

PLOTS.	Shelled Grain (Bushels).	Stover (Pounds).
Plots 1 and 3 (manure alone),	66.8	4,860
Plots 2 and 4 (manure and potash),	67.2	4,540

It will be noticed that the crops are of practically equal value, — a little more grain on the manure and potash and a little more stover on the larger quantity of manure alone. The manure and potash used cost per acre nearly $7 less than the larger amount of manure used alone.

We have now grown seven corn crops on this field, and the average yields are at the rate per acre for the two manurings: —

Average of Seven Crops.

PLOTS.	Shelled Grain (Bushels).	Stover (Pounds).
Manure alone,	61.5	4,562
Lesser manure and potash,	56.7	4,168

At prices which have prevailed during the period covered by this experiment the total manurial application where the manure and potash have been used has cost at the rate of $75 per acre less than on the other plots. The manure alone, however, has produced yields excelling the lesser manure and potash for the entire period at rates per acre amounting to: shelled corn, 33.6 bushels; corn stover,

2,758 pounds ; hay, 2,244 pounds ; and rowen, 1,170 pounds. These products would have been worth $46.50. In using the large amount of manure alone, then, one would in effect, allowing the manure to cost $5 per cord on the land, have expended $75 for products worth but little more than one-half that sum.

When, further, we note that at present the lesser manure and potash is producing the larger crop of grain, the superior economy of the system is evident.

"Special" Corn Fertilizer *v.* Fertilizer richer in Potash.

This experiment was begun with a view to comparing the results obtained with a fertilizer proportioned like the average *"special" corn fertilizers* found upon the markets in 1891 with those obtained with a fertilizer richer in potash, but furnishing less nitrogen and phosphoric acid.

Corn was grown during each of the years from 1891 to 1896 inclusive. From 1891 to 1895 it was found that the fertilizer richer in potash gave the more profitable results. In 1896 there was no practical difference. It was decided during the season of 1896 that it might be possible to derive a greater benefit from the larger quantity of potash applied to two of the four plots, if grass and clover should be grown in rotation with the corn. Accordingly the land was seeded with a mixture of timothy, red-top and clover in the standing corn in July, 1896. The field is divided into four plots, of one-fourth of an acre each. The materials supplied to the several plots are shown in the following table : —

FERTILIZERS.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	20.0	18.0
Dried blood,	30.0	30.0
Dry ground fish,	30.0	20.0
Plain superphosphate,	226.0	120.0
Muriate of potash,	22.5	60.0
Cost of materials per plot,	$3 23	$3 10

The field was kept in grass for two years, the average yields being at the rates per acre : " Special " fertilizer : hay, 2,730 pounds ; rowen, 1,122 ; fertilizer richer in potash : hay, 2,557.5 pounds ; rowen, 1,149 pounds. The "special," it will be seen, gave yearly 172.5 pounds more hay but 27 pounds less rowen than the other fertilizer. The larger nitrogen application accounts for the excess in hay ; the larger potash application to the other plot produces the more rowen. The stand of clover in the field was poor. It is believed that, had it been good, the differences in yield of rowen in favor of the fertilizer richer in potash would have been larger.

The sod was ploughed in the autumn of last year, fertilizers as usual applied and wheel-harrowed in this spring. The crop this year was corn, which made perfectly normal and good growth on all plots and gave a good yield.

Yield of Corn, 1899.

PLOTS.	Ears (Pounds).	Stover (Pounds).
Plot 1 (lesser potash),	1,257.5	1,090
Plot 2 (richer in potash),	1,141.0	1,140
Plot 3 (lesser potash),	1,168.5	1,120
Plot 4 (richer in potash),	1,200.5	1,120

Average Rates per Acre.

PLOTS.	Shelled Grain (Bushels).	Stover (Pounds).
Plots 1 and 3,	60.7	4,420
Plots 2 and 4,	58.5	4,520

The crops this year are almost equal, — the "special" giving a little more than 2 bushels more grain ; the fertilizer, richer in potash, 100 pounds more stover. The former gives somewhat the more valuable and the more profitable crop. The advantage, however, is insignificant, amounting to only 25 cents per acre.

The experiment has now been in progress nine years, and during seven of these years corn has been grown; on all plots five years and on two only of the plots two years. The averages for the seven years are given in the table: —

Average Yield Corn, Seven Years.

	Shelled Grain (Bushels per Acre).	Stover (Pounds per Acre).
"Special" fertilizer, ...	57.95	3,760
Fertilizer richer in potash, ...	50.41	4,033

During two years one-half this field was occupied by Japanese millet (*Panicum Italicum*). The average yields per year are shown in the table: —

Averages, Millet, Two Years.

	Millet Seed (Bushels per Acre).	Straw (Pounds per Acre).
"Special" fertilizer, ...	63.15	3,522
Fertilizer richer in potash, ...	66.55	3,735

It will be seen, then, that thus far the two systems of manuring stand nearly upon an equality. The fertilizer poorer in potash ("special") has given the more corn and the more hay. The other fertilizer, richer in potash, has given the more corn stover, rowen, millet seed and millet straw. At present the two stand practically equal, as shown by the corn crop of the past season, It is believed that by the frequent introduction of clover (of which we have not yet had a good catch) the fertilizer richer in potash will prove superior to the other.

Sulfate compared with Muriate of Potash for Various Crops. (Field B.)

This experiment has been in progress in its present essential features since 1893. From 1884 to 1889 the odd numbered plots, 11 to 21, were manured yearly at the rate of 200 pounds per acre of muriate of potash, while the even

numbered plots received no potash. From 1889 to 1892 all plots were manured alike. Since 1892 each plot has received yearly bone meal at the rate of 600 pounds per acre, the odd numbered plots muriate of potash at the rate of 400 pounds, and the even numbered plots high-grade sulfate of potash at the same rate per acre. There are eleven plots, numbered 11 to 21. These plots have been used for a wide variety of crops during the seven years that the experiment has been continued. The crops during the past year have been sugar beets, sweet corn, cabbages, field corn and soy beans.

Sugar Beets (Sulfate v. Muriate of Potash).

Sugar beets of four varieties occupied plots 15 and 16. The yield on 15 (muriate of potash) amounted to 3,815 pounds (14.3 tons) per acre; the yield on 16 (sulfate of potash) amounted to 3,708 pounds (13.9 tons) per acre. Each variety was sampled and the value of the beets for sugar manufacture determined. With one exception the beets grown on the sulfate of potash showed considerably higher percentages of sugar and a juice of a higher degree of purity than those grown on the muriate. Though the latter gave a slightly higher yield, the sulfate produced more sugar and a juice offering less difficulties in manufacture. In the case of the one variety where the muriate gave the richer beet, it is believed that this was due to the fact that the sulfate beets selected for analysis were considerably larger than the others. The differences in quality between the beets grown on the two salts were not sufficiently great to materially affect their value for stock feeding.

Sweet Corn (Sulfate v. Muriate of Potash).

This crop (Moore's Concord) occupied plots 11 and 12. Our objects were: first, to study the effect of the two forms of potash on yield; second, to determine whether there was any difference in quality between the product of the two plots which would affect its value for the table; and, third, to determine whether there was any well-defined difference in composition of the entire plant (stalk and ear) which would affect the value for stock feeding.

1. *Product.* — The details concerning product are shown in the table : —

Sweet Corn.

	Weight of Entire Crop (Pounds).	Number of Ears.		Total Ears (Pounds).	Weight of Stover (Pounds).
		Large.	Small.		
Muriate of potash, . .	4,965	1,411	335	929.69	4,035.31
Sulfate of potash, . .	4,965	1,574	377	1,034.36	3,930.64

In the judgment of the men handling the crop, the plants stood slightly thicker on plot 12 than on plot 11, and it is likely that this accounts in large measure, if not entirely, for the greater number of ears on plot 12. It will be noticed that the total product was the same on the two plots.

2. *Quality for Table Use.* — Chemical examination of kernels of corn from the two plots showed no difference which can be regarded as significant ; in fact, the differences are probably within the limits of error. It therefore appears that the chlorine of muriate did not exert the depressing effect on sugar formation that is often noticed with other crops.

3. *The Food Value of the Entire Plant.* — Analyses of the product of the two plots revealed no differences in composition which would materially affect the feeding value.

Field Corn (*Eureka for the Silo*) (*Sulfate v. Muriate of Potash*).

This crop occupied plots 19 and 20, and on both made a fine growth, averaging 15 feet in height. The ears were small and in the milk when the crop was ensiled, September 28. The yields (obtained by weighing after partial wilting) were : —

Muriate plot, 6,145 pounds, at rate of 23 tons per acre.

Sulfate plot, 5,675 pounds, at rate of 21.2 tons per acre.

Feeding Value. — The crop from both plots was sampled for analysis. The results showed no important differences in the feeding value of the product on the two salts.

Maercker * has quoted Moser to the effect that corn raised on muriate of potash contains more protein, and therefore has a higher food value, than when grown on sulfate. Three experiments here, one in 1898 and the two this year, have not shown this to be the case. It would appear that the muriate of potash is equally as good for the corn crop as the sulfate.

Soy Beans (*Sulfate v. Muriate of Potash*).

Through accident the product of the soy bean plots was mixed; and I can only report that during the early part of the season the beans on the sulfate appeared much better than the others. Later this apparent superiority was lost in large measure, as judged after careful examination.

Cabbages (*Sulfate v. Muriate of Potash*).

This crop (Warren cabbage) occupied plots 13 and 14. The growth on the sulfate of potash was from the start much better than on the muriate, and this superiority was maintained throughout the season. The yield is shown in the table: —

	Number of Hard Heads, November 2.	Total Weight (Pounds).		Loose Leaves (Pounds).
		Hard Heads.	Soft Heads.	
Muriate of potash,	393	4,105	720	750
Sulfate of potash,	502	5,475	255	1,060

It will be noticed that the sulfate of potash plot gave much the larger and more valuable crop. It should be pointed out that, on account of difference of growth due to accidental conditions, the above table has been made to include the yield for only about one-ninth of an acre. The product of plot 14 sold at a price (5 cents per head) which would have made the product of one acre of such cabbages worth about $250, while the product of the other plot was worth only at the rate of about $200 per acre.

* Die Kalidungung, p. 252.

Comparison of Different Potash Salts. (Field G.)

The object in this experiment is to determine the relative manurial value for our various crops of the different prominent potash salts. The experiment was begun in 1898, the crop that year being the soy bean. The results were indecisive and unsatisfactory, the crop where no potash was used in numerous instances being as great as where potash manures were applied. The potash resources of the soil were clearly too large to allow satisfactory deductions to be made. This had, however, been anticipated. From the nature of the problem it was recognized that the experiment must continue for a series of years. We must study not simply the immediate effect upon the crop, but the effect upon the soil of long-continued use of the different salts, — and as well the effect upon the crop of such continued use.

In this experiment the plots are one-fortieth of an acre each, duly separated by dividing strips. There are forty plots, each manuring being five times duplicated. Every plot receives yearly materials estimated to furnish nitrogen and phosphoric acid in liberal amounts. All receive the same materials, save plots 6, 14, 22, 30 and 38, on which the potash salt used is the nitrate, so that the amount of nitrate of soda for these is made only sufficient (.5 pounds) to furnish to these plots the same amount of nitrate nitrogen as to the others. With this exception, the materials applied as sources of nitrogen and phosphoric acid are, per plot: —

	Pounds.
Nitrate of soda,	7.0
Tankage,	7.5
Acid phosphate,	10.0

In order to make certain that there should be no failure through deficiency of lime, the entire field received an application at the rate of one ton to the acre of lime freshly slacked, which was wheel-harrowed in early in the spring of 1898.

The various potash salts where used were applied in amounts intended to furnish an equal quantity of actual potash (K_2O) to each plot, as follows: —

		Pounds.
Plot 1.	No potash.	
Plot 2.	Kainite,	27.75
Plot 3.	High-grade sulfate of potash,	7.50
Plot 4.	Low-grade sulfate of potash,	15.00
Plot 5.	Muriate of potash,	7.50
Plot 6.	Nitrate of potash,	8.25
Plot 7.	Carbonate of potash-magnesia,	20.00
Plot 8.	Silicate of potash,	17.00

Plots 9–16, 17–24, 25–32 and 33–40 are duplicates respectively of plots 1–8.

The crop this year (the second of the experiment) was potatoes, Beauty of Hebron, seed from Maine. It was planted in drills, one set (2–3 eyes) in 14 inches. The tubers were subjected to the formalin treatment, to prevent scab, being soaked two hours in a solution of eight ounces to 15 gallons of water. They were budded in a light room after treatment, before being planted on May 8–9. The crop was well cared for, and sprayed repeatedly with Bordeaux mixture, to prevent blight, of which there was little. The yield was heavy, varying from 297 to 380 bushels of merchantable potatoes per acre on the different potash salts. The results are not entirely conclusive, for the reason that in duplicate plots the yields of the different salts do not occupy the same relative rank. Thus, for example, the various salts made the following relative yields in merchantable tubers : —

Kainite stands : —
1st, once ; 3d, once ; 6th, twice ; and 7th, once.
High-grade sulfate of potash stands : —
1st, twice ; 2d, twice ; and 3d, once.
Low-grade sulfate of potash stands : —
2d, twice ; 3d, once ; 6th, once ; and 7th, once.
Muriate of potash stands : —
1st, once ; 4th, twice ; 5th, once ; and 6th, once.
Nitrate of potash stands : —
Once each : 3d, 4th, 5th, 6th and 7th.
Carbonate of potash-magnesia stands : —
1st, twice ; 3d, twice ; and 5th, once.
Silicate of potash stands : —
4th, twice ; 6th, twice ; and 7th, once.

With such variations in relative standing, it will be agreed we must interpret results with caution. Still, it is believed that the average yield of the different salts should be published as a matter of record : —

Average Yield of Plots.

PLOTS.	Pounds per Plot.		Bushels per Acre.	
	Large.*	Small.	Large.*	Small.
No potash,	430.70	61.00	287.13	40.66
Kainite,	488.45	52.60	326.83	33.86
High-grade sulfate,	525.70	52.95	350.46	35.49
Low-grade sulfate,	508.20	55.70	338.79	37.13
Muriate,	506.30	61.40	337.53	40.93
Nitrate,	498.20	64.75	332.13	43.16
Carbonate,	518.00	64.80	345.33	43.39
Silicate,	492.40	56.00	328.26	38.39

* Two ounces or over.

Conclusions.

1. It will be noticed that the soil is potash hungry, for every one of the salts used increases the yield.

2. The high-grade sulfate of potash stands first. It has with rare exceptions been found more effective in increasing the yield than the muriate, with which it has been frequently compared, and it gives better quality. We are justified in the conclusion that the application of potash in this form for the potato will give good results. It should be pointed out that our soil is moderately heavy and retentive. On drier sorts the muriate may compare with the sulfate more favorably.

3. The comparatively new carbonate of potash-magnesia ranks second. It is as carbonate that potash exists in wood ashes, which, however, are believed to favor some forms of scab. The fertilizer did not have that effect. This appears to be, then, a very useful form of potash. In mechanical condition it leaves nothing to be desired, being fine and remaining dry under all conditions of weather. The price is at present too high to allow its general use.

4. The low-grade sulfate of potash ranks third; but, as freights cost more per unit of potash for this salt than for the high grade, the latter is generally to be preferred. It is not impossible that in some localities the magnesia of the low-grade sulfate may prove useful; but we have no evidence that such is the case here.

5. The kainite ranks lowest among all the salts employed. Since this, containing only about 13 per cent. of actual potash, can be purchased at a much lower ton price than the purer salts, such as the high-grade sulfate and the muriate, it is sometimes selected by farmers. It should be remembered that the unit of potash on the farm usually costs more in the kainite than in the others. In view of our results, then, I can see no reason for selecting this potash fertilizer.

6. The silicate of potash gives the next lowest crop. It is apparently slowly available. The present cost is high, and it can be kept from caking only by admixture with powdered peat or similar material. It is prepared especially for use on tobacco, for which crop it is under trial in Germany and in this country. I judge it will have no application for ordinary crops; and its usefulness for tobacco is not fully demonstrated, though some favorable results have been obtained.

Leguminous Crops (Clover, Pea and Bean or "Pod" Family) as Nitrogen Gatherers. (Field A.)

This experiment is a continuation of a series begun in 1889. The objects in view have been: —

1. To determine the extent to which plants of the clover family are capable of enriching the soil in nitrogen taken by them from the air through the agency of the nodular bacteria found upon their roots.

2. To compare nitrate of soda, sulfate of ammonia, dried blood and farm-yard manure as sources of nitrogen.*

The plots, eleven in number, are one-tenth acre each, and are numbered 0 to 10. Three plots (4, 7 and 9) have re-

* Only such details are given here as are necessary to an understanding of the nature of the experiment. Full particulars will be found in our ninth and tenth annual reports.

ceived no nitrogen-containing manure or fertilizers since 1884; one (0) has received farm-yard manure; two (1 and 2), nitrate of soda; three (5, 6 and 8), sulfate of ammonia; and two (3 and 10), dried blood every year since 1889. These materials have been used in amounts to furnish nitrogen at the rate of 45 pounds per acre each year.

All plots have received yearly equal quantities of phosphoric acid and potash; viz., 80 pounds per acre of the former and 125 pounds of the latter from 1889 to 1894 and the past four seasons; but in 1894 and 1895, double these quantities. To some of the plots the potash is applied in the form of potash-magnesia sulfate; to others, in the form of muriate. The results with the former salt have been superior to those with the latter, as a rule, particularly when used in connection with sulfate of ammonia. The entire field received at the rate of 1 ton per acre of partially air-slacked lime in the spring of 1898, in addition to the usual fertilizers.

Up to this year we may briefly characterize the results, in so far as these have a bearing upon the two main questions proposed, as follows: —

1. The leguminous crops grown (soy beans in 1892, 1894 and 1896) have not appeared to enrich the soil in nitrogen, if we accept the results with the next following crop as affording a basis of judgment.

2. The different sources of nitrogen have ranked on the average in the following order: nitrate of soda, farm-yard manure, dried blood and sulfate of ammonia.

The crop in 1898 was oats. After harvesting them, the land was ploughed and sown to what was supposed to be mammoth red clover in August. The variety appears to be the common red. This went into the winter in excellent condition, but was somewhat winter-killed on all plots, apparently for reasons unconnected with the manures which had been employed. The injury was most severe on plots 0, 5 and 8, and least on plot 5. Between the other plots there was little difference in the degree of injury, if we except plot 6, on which it was greater than on the others. Seed was sown on the surface this spring where needed. This germinated well, but the young plants made little growth, on account of the dry weather. Two crops were

cut, the first on July 3. The plants at this time had ceased growth, on account of drought. Not all had blossomed, yet the condition must be classed as mature. The yield was seriously decreased by the dry weather. The second crop was cut August 21, being somewhat mixed with annual grasses, but apparently to equal degree in all plots. The hay was secured in good condition, being cured mostly in the cock. The table shows the fertilizer treatment and the yields of the several plots : —

Nitrogen Experiment, — Fertilizers used and Yield of Clover.

Plots.	FERTILIZERS.	Pounds.	Clover Hay (Pounds).	Clover Rowen (Pounds).	Total (Pounds).
Plot 0,	Barn-yard manure, . . Potash-magnesia sulfate, . Dissolved bone-black, . .	800.0 32.0 18.0	220.0	288.3	508.3
Plot 1,	Nitrate of soda, . . . Potash-magnesia sulfate, . Dissolved bone-black, . .	29.0 48.5 50.0	200.0	243.8	443.8
Plot 2,	Nitrate of soda, . . . Potash-magnesia sulfate, . Dissolved bone-black, . .	29.0 48.5 50.0	220.0	202.6	422.6
Plot 3,	Dried blood, ... Muriate of potash, . . . Dissolved bone-black, . .	43.0 25.0 50.0	120.0	225.8	345.8
Plot 4,	Muriate of potash, . . . Dissolved bone-black, . .	25.0 50.0	140.0	196.8	336.8
Plot 5,	Ammonium sulfate, . . Potash-magnesia sulfate, . Dissolved bone-black, . .	22.5 48.5 50.0	140.0	202.1	342.1
Plot 6,	Ammonium sulfate, . . Muriate of potash, . . . Dissolved bone-black, . .	22.5 25.0 50.0	140.0	235.6	375.6
Plot 7,	Muriate of potash, . . . Dissolved bone-black, . .	25.0 50.0	180.0	162.9	342.9
Plot 8,	Ammonium sulfate, . . Muriate of potash, . . . Dissolved bone-black, . .	22.5 25.0 50.0	200.0	207.5	407.5
Plot 9,	Muriate of potash, . . . Dissolved bone-black, . .	25.0 50.0	215.0	206.5	421.5
Plot 10,	Dried blood, ... Potash-magnesia sulfate, . Dissolved bone-black, . .	43.0 48.5 40.0	215.0	241.5	456.5

It is perhaps questionable whether much weight should be attached to the yields at the first cutting, since full development was not reached on account of drought. The rowen gives a better basis for comparison. Studying these figures, we find the following points bearing upon the problem on which the experiment seeks to shed light : —

1. *The various materials furnishing nitrogen rank in the following order: manure, dried blood, nitrate of soda and sulfate of ammonia.*

2. *The plots receiving no nitrogen approach in average yield much more closely to those getting this element than has been the case with any previous crop on this land. This must be regarded as highly significant, for it will be remembered that this field has been under experiment for eleven years, and in all that time these plots have received no nitrogenous manure or fertilizer of any kind. The clover must, it seems evident, have drawn from the air for this element, in which, as is well known, it is especially rich.*

Fertilizers for Garden Crops. (Field C.)

This series of experiments was begun in 1891, and has for its objects to test the relative value for garden crops: (1) of sulfate of ammonia, nitrate of soda and dried blood as sources of nitrogen; and (2) of muriate and sulfate as sources of potash. For full details concerning the methods followed and earlier results, reference is made to my eleventh annual report. It should, however, be pointed out here that partially rotted stable manure has been applied in equal amounts to all the plots for the last two years. The amount of such manure used this year was 7,200 pounds per plot. The fertilizers used were as follows: —

Annual Supply of Manurial Substances (Pounds).

Plot 1,	Sulfate of ammonia,	38
	Muriate of potash,	30
	Dissolved bone-black,	40
Plot 2,	Nitrate of soda,	47
	Muriate of potash,	30
	Dissolved bone-black,	40
Plot 3,	Dried blood,	75
	Muriate of potash,	30
	Dissolved bone-black,	40
Plot 4,	Sulfate of ammonia,	38
	Sulfate of potash,	30
	Dissolved bone-black,	40
Plot 5,	Nitrate of soda,	47
	Sulfate of potash,	30
	Dissolved bone-black,	40
Plot 6,	Dried blood,	75
	Sulfate of potash,	30
	Dissolved bone-black,	40

The area of the plots is about one-eighth of an acre each. The fertilizers used supply at the rates per acre: phosphoric acid, 50.4 pounds; nitrogen, 60 pounds; potash, 120 pounds. For purposes of comparison, I quote from my last annual report: —

Conclusions based on Results up to 1897. (Fertilizers Alone.)

The chief conclusions which seemed justified by the results with fertilizers alone are the following: —

1. Sulfate of potash in connection with nitrate of soda (plot 5) has generally given the best crop. In those cases where this has not been true, the inferiority of this combination has usually been small. In one case only has it fallen much behind, viz., with sweet corn, a crop which makes much of its growth in the latter part of the season.

2. Nitrate of soda (plots 2 and 5) has in almost every instance proved the most valuable source of nitrogen, whether used with the muriate or the sulfate of potash.

3. The combination of sulfate of ammonia and muriate of potash (plot 1) has in every instance given the poorest crop. This fact is apparently due, as Dr. Goessmann has pointed out, to an interchange of acids and bases leading to the formation of chloride of ammonia, which injuriously affects growth.

The Experiment in 1899.

The crops on each plot this year included the following: fruiting strawberries, celery (following the strawberries), cabbages, squashes, spinach, lettuce, table beets, onions and freshly set strawberries. Both manure and fertilizers were spread on after ploughing this spring and harrowed in.

Strawberries: — The vines of the fruiting beds were set in the spring of 1898. They all made good growth, but were somewhat winter-killed, apparently because covered rather too heavily. The injury was not very materially different on the different plots, but was judged to have been somewhat most serious on plots 0 and 2 and least on plot 4. Picking began on June 15 and ended on July 12. Plot 0 (manure alone) much exceeded the others in yield of ripe fruit at first, and in aggregate yield was excelled by but two of the plots. The total yields in pounds per plot were as follows: plot 0, 126.6 pounds; plot 1, 94.7 pounds; plot

2, 96.6 pounds; plot 3, 155.1 pounds; plot 4, 172.3 pounds; plot 5, 108.1 pounds; plot 6, 103.3 pounds.

The average yields in pounds produced by the different fertilizers* were: —

Manure alone (plot 0),	126.6
Average of manure and muriate of potash (plots 1, 2 and 3),	115.4
Average of manure and sulfate of potash (plots, 4, 5 and 6),	128.8
Average of manure and sulfate of ammonia (plots 1 and 4),	161.9
Average of manure and nitrate of soda (plots 2 and 5),	102.3
Average of manure and dried blood (plots 3 and 6),	129.2

It will be noticed that but two of the combinations of fertilizers used with the manure excel the manure alone, viz., sulfate of ammonia and sulfate of potash, and dried blood and muriate of potash. Nitrate of soda, which we have found the best source of nitrogen for most crops, makes the poorest showing. Between the muriate and sulfate of potash there seems to be no clearly defined difference. These results were doubtless in part determined by the degree of winter injury.

Celery. — This crop followed the strawberries without extra manuring. The share of the stable manure belonging to the fruiting strawberry area was, however, applied when the strawberry vines were turned in. The yields of the several plots in pounds were as follows: plot 0, 720.8; plot 1, 250; plot 2, 550; plot 3, 510; plot 4, 190; plot 5, 585; plot 6, 550.

The average yields in pounds produced by the different fertilizers were: —

Manure alone,	720.8
Manure and muriate of potash (plots 1, 2 and 3),	436.7
Manure and sulfate of potash (plots 4, 5 and 6),.	441.7
Manure and sulfate of ammonia (plots 1 and 4),	220.0
Manure and nitrate of soda (plots 2 and 5),	567.5
Manure and dried blood (plots 3 and 6),	530.0

* To enable the reader to better make comparisons, the plots are characterized as "manure and muriate of potash," "manure and sulfate of potash," etc. It should be remembered that dissolved bone-black was applied to all except plot 0, and that every plot except plot 0 received material supplying both nitrogen and potash as well as phosphoric acid in addition to the manure. For the full list of fertilizers applied to each plot, see page 35.

It will be noted that the manure alone gave much the largest crop.* Discussion as to the effect of the fertilizers, then, hardly seems called for. It is not without interest, however, to note that the crops where sulfate of ammonia was employed were much the smallest in the field. The result last year was similar in this respect.

Hanson Lettuce. — In harvesting this crop the heads of market size were cut from day to day. The total yields per plot in pounds were: plot 0, 83.1; plot 1, 54.75; plot 2, 129.25; plot 3, 150.50; plot 4, 88.5; plot 5, 148; plot 6, 122.25.

The average yields in pounds on the different fertilizers were: —

Manure alone (plot 0), ...	83.1
Manure and muriate of potash (plots 1, 2 and 3), .	111.5
Manure and sulfate of potash (plots 4, 5 and 6), . .	119.6
Manure and sulfate of ammonia (plots 1 and 4), .	71.6
Manure and nitrate of soda (plots 2 and 5), . .	138.6
Manure and dried blood (plots 3 and 6), . . .	136.4

The sulfate of potash proves somewhat superior to the muriate; but the most marked result is the highly unfavorable influence of the sulfate of ammonia. This, as in previous years, in combination with the muriate of potash acts as a plant poison.

Spinach. — This, like the lettuce, was cut from time to time as it became ready for market. The yields in pounds of the several plots were: plot 0, 83.8; plot 1, 3; plot 2, 36.8; plot 3, 46.5; plot 4, 42; plot 5, 75.25; plot 6, 56.5.

The averages on the several fertilizers in pounds were: —

Manure alone (plot 0), ...	83.8
Manure and muriate of potash (plots 1, 2 and 3), .	28.8
Manure and sulfate of potash (plots 4, 5 and 6), . .	57.9
Manure and sulfate of ammonia (plots 1 and 4), . .	22.5
Manure and nitrate of soda (plots 2 and 5), . . .	56.0
Manure and dried blood (plots 3 and 6), ...	51.5

It is noticeable that manure alone produces a considerably larger crop than manure with any combination of fertilizers.

* In explanation of this fact, it should be pointed out that plot 0 previous to 1898 had entirely different manuring and cropping from the other plots. See last annual report. It is not believed that the fertilizers were injurious, as a rule.

The most marked effect is the injurious influence of the sulfate of ammonia.

Onions. — The yields of the several plots are shown in the table : —

PLOTS.	Well-cured Onions (Pounds).	Well-formed Onions, but not cured (Pounds).	Scallions (Pounds).
Plot 0,	1,334.5	26.5	13.0
Plot 1,	214.8	108.5	108.3
Plot 2,	1,174.0	75.0	24.0
Plot 3,	761.5	184.0	157.0
Plot 4,	632.7	248.5	93.0
Plot 5,	1,415.8	81.0	17.0
Plot 6,	929.3	243.8	79.8

The averages on the several fertilizers were : —

	Merchantable (Pounds).	Green (Pounds).	Scallions (Pounds).
Manure alone (plot 0),	1,334.5	26.5	13.0
Manure and muriate of potash (plots 1, 2 and 3),	716.8	122.5	96.4
Manure and sulfate of potash (plots 4, 5 and 6),	992.6	191.1	63.3
Manure and sulfate of ammonia (plots 1 and 4),	423.7	178.5	100.6
Manure and nitrate of soda (plots 2 and 5),	1,294.9	78.0	20.5
Manure and dried blood (plots 3 and 6),	845.4	213.9	118.9

It becomes evident from these figures (1) that none of the fertilizer combinations except one (nitrate of soda and sulfate of potash) benefited the crop, (2) that the sulfate is much superior to the muriate as a source of potash, and (3) that the nitrate of soda is much the best source of nitrogen.

Table Beets. — With this crop the manure alone gave much the best yields, and the several fertilizer combinations failed to produce effects sufficiently marked to warrant discussion. The details, therefore, will not be given.

Cabbages. — But one plot in this crop gave a yield excelling the manure alone, and that was the one receiving, in addition to manure, sulfate of ammonia and muriate of potash. The yields in hard heads in pounds were as follows :

plot 0, 375.1; plot 1, 420; plot 2, 377.5; plot 3, 337.5; plot 4, 347.5; plot 5, 207.5; plot 6, 320.

The averages on the several fertilizers in pounds were: —

	Hard Heads.	Soft Heads.
Manure alone (plot 0),	375.1	223.9
Manure and muriate of potash (plots 1, 2 and 3),	378.3	29.2
Manure and sulfate of potash (plots 4, 5 and 6),	291.7	29.2
Manure and sulfate of ammonia (plots 1 and 4),	383.7	12.5
Manure and nitrate of soda (plots 2 and 5),	292.5	52.5
Manure and dried blood (plots 3 and 6),	328.6	22.5

So far as results justify conclusions, it would seem (1) that the muriate shows itself superior to the sulfate of potash for this crop *when used with stable manure*, and (2) that the sulfate of ammonia is the best source of nitrogen for it. That the sulfate of ammonia should prove the most useful form of nitrogen supply with a crop making most of its growth in the latter part of the season we have before observed.*

In other experiments with cabbages this year, where fertilizers alone were used, the sulfate of potash gave much larger yields than the muriate.† Here this is reversed. I have at present no explanation to offer for this difference.

Squashes. — This crop gave much the best yield on manure alone, and the differences apparently produced by the several fertilizers are not significant. The sulfate gives larger yields than the muriate of potash in every case, while the sulfate of ammonia makes the lowest showing among the fertilizers supplying nitrogen. The details will not be given.

Variety Tests with Potatoes.

The number of varieties tested this year was 94. The seed used was all of our own raising. It was produced under conditions similar in every respect and had been similarly preserved. Of each variety, with a few exceptions later noted, 80 sets were planted at the distance of 1 foot

* See eleventh annual report. † See page 28.

in drills 3 feet apart. One-half of these were harvested at early market maturity (August 1), the balance at full maturity (September 22–23).

The soil was a medium loam, in mixed grass and clover for the two preceding years. It received an application of farm manure at the rate of about 5 cords per acre on the sod early this spring, and was then ploughed. The fertilizers used in pounds per acre were: —

Nitrate of soda,	240
Acid phosphate,	400
Sulfate of potash (high grade),	250
Tankage,	240
Dried blood,	100

These materials were thoroughly mixed and scattered widely in the open furrow before dropping the seed. The seed potatoes were first washed and then treated in formalin solution (8 ounces to 15 gallons water) for two hours. The tubers were budded in a light room after treatment. The planting was done May 4 and 5. The crop was well cared for, and sprayed six times with Bordeaux mixture, to prevent blight, of which, however, there was considerable. The development was normal, save for the blight; and the yields and quality for the most part good. There was practically no scab.

The tables give data for the earlier and the latter diggings: —

Variety Test Potatoes. Record to Aug. 1, 1899.

VARIETY.	First Bloom.	Blight begins.	Amount of Blight August 1.*	YIELD AT RATE PER ACRE. Large, Two Ounces (Bushels).	Small (Bushels).
Abundance,	June 23,	July 22,	1/16	148.5	24.3
Acme,	June 23,	July 19,	1/2	244.0	24.3
Algoma,	June 28,	July 22,	1/4	154.5	40.9
American Beauty,	June 17,	July 22,	1/4	200.0	10.6
Arizona,	June 17,	July 18,	1/4	224.3	51.5
Bartlett,	June 28,	July 24,	1/16	181.8	36.4
Beauty of Hebron,	June 19,	July 24,	1/8	260.6	40.9

* Fractions indicate proportion of foliage destroyed.

Variety Test Potatoes, etc. — Continued.

VARIETY.	First Bloom.	Blight begins.	Amount of Blight August 1.	YIELD AT RATE PER ACRE. Large, Two Ounces (Bushels).	Small (Bushels).
Burpee's Superior, . .	June 23,	July 22,	⅛	236.4	39.4
Burr's No. 1, . . .	June 19,	July 22,	¼	262.1	45.5
Cambridge Russet, . .	June 23,	July 18,	¼	166.7	24.3
Carmen No. 1, . . .	June 19,	July 22,	⅝	295.5	30.3
Champion of the World, .	June 19,	July 22,	⅛	206.1	31.8
Clay Rose, ...	June 17,	July 18,	¼	239.4	39.4
Commercial, ...	June 28,	July 22,	¼	209.1	12.1
Country Gentleman, . .	June 19,	July 22,	⅛	251.5	33.3
Dakota Red, ...	June 30,	July 18,	½	184.9	27.3
Dreer's Standard, . .	June 23,	July 22,	¼	272.8	21.2
Dutton's Seedling, . .	June 19,	July 22,	⅛	298.5	36.4
Early Kansas, . . .	June 19,	July 22,	⅛	298.5	33.3
Beauty of Hebron, . .	June 19,	July 24,	Trace.	287.9	31.8
Early Minnesota, . . .	June 28,	July 18,	⅜	190.9	27.3
Early Roberts, . . .	June 19,	July 22,	⅜	300.0	63.6
Early Rochester, . . .	June 19,	July 22,	⅜	230.3	15.2
Early Rose, ...	June 19,	July 18,	½	263.6	51.5
Early Sunrise, . . .	June 19,	July 18,	¼	221.2	51.5
Extra Early Vermont, .	June 19,	July 15,	⅜	266.7	42.4
Empire State, . . .	June 28,	July 22,	¼	148.5	24.3
Enormous, ...	June 19,	July 22,	⅛	275.8	9.1
Everett, ...	June 19,	July 15,	½	207.6	45.5
Fillbasket, ...	June 17,	July 20,	1/16	223.0	51.5
Garfield, ...	June 19,	July 22,	⅛	193.9	33.3
German Queen, . . .	June 19,	July 22,	¼	213.7	24.3
Good Times, . . .	July 6,	July 29,	Trace.	151.5	21.2
Governor Rusk, . . .	June 28,	July 20,	⅜	236.4	9.1
Green Mountain, . . .	June 23,	July 24,	⅛	127.3	18.2
Howard, ...	June 19,	July 24,	⅛	275.8	33.3
Hurst, ...	June 28,	July 15,	¾	-	-
Mill's Longkeeper, . .	June 23,	July 20,	¼	-	-
Irish Cobbler, . . .	June 17,	July 20,	⅜	260.6	30.3
Joseph, ...	July 6,	July 24,	¼*	169.7	28.8
King of the Earliest, . .	-	July 22,	⅜	265.2	24.3
King of Roses, . . .	June 19,	July 22,	¼	209.1	54.6
Lakeside Champion, . .	June 19,	July 20,	⅜	245.5	39.4

* Ripening.

Variety Test Potatoes, etc. — Continued.

VARIETY.	First Bloom.	Blight begins.	Amount of Blight August 1.	Yield at Rate per Acre. Large, Two Ounces (Bushels).	Small (Bushels).
Late Puritan,	June 23,	July 24,	1/8	224.3	48.5
Lee's Favorite,	June 19,	July 22,	1/4	278.8	47.0
Leonard Rose,	June 19,	July 20,	1/4	239.4	42.4
Lincoln,	June 19,	July 29,	1/8	212.1	37.9
Maule's Thoroughbred,	June 19,	July 22,	3/16	260.6	48.5
Mayflower,	–	July 22,	1/4	124.3	42.4
Mill's Banner,	June 23,	July 29,	Trace.	112.1	15.2
Mill's Prize,	June 28,	July 22,	Trace.	154.5	18.2
Money Maker,	June 23,	July 22,	1/8	145.5	12.1
Montana Wonder,	June 17,	July 22,	3/8	260.6	33.3
New Satisfaction,	June 19,	July 22,	1/4	190.9	18.2
Parker's Market,	June 23,	July 22,	1/2	218.2	30.3
Penn Manor,	June 19,	July 22,	3/8	284.9	39.4
Pingree,	June 23,	July 22,	1/4	190.9	37.3
Prince Bismark,	June 19,	July 22,	3/8	269.7	21.2
Prize Taker,	June 23,	July 22,	1/2	244.0	25.8
Early Potentate,	–	July 20,	1/2	187.9	30.3
Pride of Michigan,	June 19,	July 22,	1/4	209.1	50.0
Prolific Rose,	June 19,	July 22,	1/8	257.6	51.5
Quick Crop,	June 19,	July 22,	1/8	221.2	54.6
Reeve's Rose,	June 19,	July 22,	1/8	187.9	36.4
Restaurant,	June 23,	July 24,	1/16	212.1	36.4
Rochester Rose,	June 19,	July 22,	1/8	212.1	48.5
Rose of Erin,	June 28,	July 22,	1/4	221.2	9.1
Rose No. 9,	June 28,	July 22,	1/8	106.1	53.0
Secretary Wilson,	June 19,	July 22,	3/8*	266.7	60.6
Seneca Beauty,	June 19,	July 24,	1/8	209.1	24.3
Sir Walter Raleigh,	July 6,	July 29,	Trace.	148.5	21.2
Sir William,	June 19,	July 22,	3/8	181.8	21.2
Signal,	June 19,	July 22,	3/8	251.5	45.5
Somerset,	–	July 22,	1/8	169.7	18.2
State of Maine,	June 19,	July 24,	1/8	221.2	24.3
State of Wisconsin,	June 19,	July 22,	1/8	121.2	37.3
Table King,	June 23,	July 22,	3/8	230.3	25.8
Thorburn,	June 19,	July 24,	1/8	218.2	48.5
Tonhocks,	June 23,	July 22,	1/8	248.5	37.9

* Ripening.

Variety Test Potatoes, etc. — Continued.

VARIETY.	First Bloom.	Blight begins.	Amount of Blight August 1.	Yield at Rate per Acre.	
				Large, Two Ounces (Bushels).	Small (Bushels).
Uncle Sam,	June 19,	July 22,	1/4	293.9	12.1
Vanguard,	June 19,	July 22,	1/8	277.6	34.9
Vick's Perfection,	June 19,	July 22,	1/8	284.9	39.4
Victory, P. and W.,	June 19,	July 22,	1/16	278.8	36.4
Vigorosa,	June 19,	July 24,	1/8	294.0	40.9
Washington,	June 23,	July 24,	1/16	240.9	28.8
White Elephant,	June 19,	July 29,	1/16	218.2	31.4
White Ohio,	June 23,	July 22,	1/4	230.3	24.3
White Peachblow,	June 23,	July 24,	1/16	125.9	42.4
Wisconsin Beauty,	June 19,	July 22,	1/4	251.5	25.8
Woodbury's White,	June 23,	July 22,	1/16	133.3	31.8
Early Andees,	June 23,	July 22,	1/4	–	–
Early Dawn,	June 28,	July 20,	1/4	–	–
Salzer's Earliest,	June 28,	July 15,	7/8	–	–
Triumph,	June 28,	July 15,	15/16	–	–

Variety Test Potatoes. Final Records.

VARIETY.	Ripening begins.	Vines Dead.	Yield at Rate per Acre, September 22 and 23.	
			Large, Two Ounces or Above (Bushels).	Small (Bushels).
Abundance,	–	Sept. 6,	230.3	21.2
Acme,	Aug. 12,	Aug. 14,	230.3	18.2
Algoma,	Aug. 12,	Aug. 24,	200.0	42.4
American Beauty,	Aug. 12,	Aug. 24,	266.7	12.1
Arizona,	Aug. 14,	Aug. 24,	236.4	30.3
Bartlett,	–	Sept. 5,	330.0	28.8
Beauty of Hebron,	Aug. 24,	Sept. 5,	342.5	48.5
Burpee's Superior,	–	Sept. 5,	266.7	30.3
Burr's No. 1,	Aug. 12,	Aug. 29,	351.5	36.4
Cambridge Russet,	Aug. 12,	Aug. 24,	233.4	22.7
Carmen No. 1,	Aug. 12,	Aug. 24,	287.9	36.4
Champion of the World,	Aug. 24,	Sept. 5,	269.7	42.4
Clay Rose,	Aug. 20,	Aug. 30,	281.8	33.3

Variety Test Potatoes, etc. — Continued.

VARIETY.	Ripening begins.	Vines Dead.	Yield at Rate per Acre, September 22 and 23.	
			Large, Two Ounces or Above (Bushels).	Small (Bushels).
Commercial,	Aug. 14,	Aug. 30,	197.0	3.0
Country Gentleman,	Aug. 20,	Aug. 30,	315.2	51.5
Dakota Red,	Aug. 19,	Aug. 24,	206.1	18.2
Dreer's Standard,	Aug. 20,	Aug. 30,	312.1	18.2
Dutton's Seedling,	Aug. 20,	Aug. 30,	363.7	60.6
Early Kansas,	Aug. 20,	Aug. 30,	330.3	30.3
Beauty of Hebron,	Aug. 24,	Sept. 5,	393.9	39.4
Early Minnesota,	Aug. 20,	Aug. 30,	278.8	12.1
Early Roberts,	Aug. 12,	Aug. 23,	315.2	54.5
Early Rochester,	Aug. 28,	Aug. 30,	278.8	21.2
Early Rose,	Aug. 20,	Aug. 30,	351.5	66.7
Early Sunrise,	Aug. 20,	Aug. 23,	309.1	75.8
Extra Early Vermont,	Aug. 12,	Aug. 23,	327.3	60.6
Empire State,	Aug. 12,	Aug. 30,	206.1	24.3
Enormous,	Aug. 12,	Aug. 30,	397.0	15.2
Everett,	Aug. 23,	Aug. 30,	215.2	66.7
Fillbasket,	Aug 20,	–	416.2	45.5
Garfield,	Aug. 20,	Aug. 30,	236.4	30.3
German Queen,	–	Aug. 30,	275.8	36.4
Good Times,	–	–	229.1	27.3
Governor Rusk,	Aug. 14,	Aug. 23,	275.8	9.1
Green Mountain,	–	–	242.5	24.3
Howard,	Aug. 12,	Aug. 30,	403.1	51.5
Hurst,*	–	Aug. 8,	193.7	38.2
Mill's Longkeeper,†	–	Sept. 5,	177.6	46.7
Irish Cobbler,	Aug. 12,	–	297.0	45.5
Joseph,	Aug. 12,	Aug. 30,	260.6	30.0
King of the Earliest,	Aug. 12,	Aug. 14,	263.6	51.5
King of the Roses,	–	–	327.3	54.5
Lakeside Champion,	–	Aug. 30,	254.6	45.5
Late Puritan,	Aug. 23,	–	336.4	39.4
Lee's Favorite,	Aug. 14,	Aug. 24,	290.9	66.7
Leonard Rose,	Aug. 22,	Sept. 5,	345.6	57.6
Lincoln,	–	Sept. 5,	357.6	30.3
Maule's Thoroughbred,	Aug. 14,	Sept. 5,	321.2	48.5

* Forty-one hills. † Thirty-nine hills.

Variety Test Potatoes, etc. — Continued.

VARIETY.	Ripening begins.	Vines Dead.	Yield at Rate per Acre, September 22 and 23. Large, Two Ounces or Above (Bushels).	Small (Bushels).
Mayflower,	–	Sept. 5,	218.2	18.3
Mill's Banner,	–	Sept. 5,	272.8	10.6
Mill's Prize,	–	Sept. 5,	290.9	12.1
Money Maker,	–	Sept. 5,	287.9	21.2
Montana Wonder,	Aug. 12,	Aug. 23,	347.0	66.7
New Satisfaction,	Aug. 22,	Sept. 5,	297.0	30.3
Parker's Market,	Aug. 12,	Aug. 23,	234.9	30.3
Penn Manor,	Aug. 12,	Aug. 23,	339.4	60.6
Pingree,	Aug. 20,	Aug. 30,	303.0	24.3
Prince Bismark,	Aug. 12,	Aug. 23,	275.8	60.6
Prize Taker,	Aug. 14,	Sept. 5,	275.8	13.6
Early Potentate,	–	Aug. 23,	230.3	36.4
Pride of Michigan,	Aug. 12,	Aug. 23,	303.0	60.6
Prolific Rose,	Aug. 14,	Aug. 30,	351.5	97.0
Quick Crop,	Aug. 23,	Aug. 30,	309.1	66.7
Reeve's Rose,	Aug. 23,	Sept. 5,	345.5	54.6
Restaurant,	–	Sept. 5,	339.4	78.8
Rochester Rose,	Aug. 14,	Sept. 5,	303.0	72.7
Rose of Erin,	Aug. 14,	Aug. 20,	254.6	6.1
Rose No. 9,	Aug. 23,	Aug. 30,	236.4	34.9
Secretary Wilson,	Aug. 12,	Aug. 23,	290.9	54.6
Seneca Beauty,	–	Sept. 5,	345.5	60.6
Sir Walter Raleigh,	Aug. 23,	Sept. 5,	260.6	18.2
Sir William,	Aug. 14,	Sept. 5,	309.1	30.3
Signal,	–	Aug. 23,	284.9	54.6
Somerset,	–	Sept. 5,	278.8	18.2
State of Maine,	Aug. 23,	Sept. 5,	333.4	27.3
State of Wisconsin,	–	Sept. 5,	272.8	15.2
Table King,	Aug. 23,	Sept. 5,	300.0	27.3
Thorburn,	Aug. 12,	Aug. 24,	357.6	48.5
Tonhocks,	Aug. 23,	Sept. 5,	327.3	57.6
Uncle Sam,	Aug. 23,	Sept. 5,	330.3	36.4
Vanguard,	–	–	381.8	69.7
Vick's Perfection,	Aug. 12,	Aug. 30,	306.1	63.6
Victory, P. and W.,	Aug. 23,	Aug. 30,	321.2	48.5

Variety Test Potatoes, etc. — Concluded.

VARIETY.	Ripening begins.	Vines Dead.	Yield at Rate per Acre, September 22 and 23.	
			Large, Two Ounces or Above (Bushels).	Small (Bushels).
Vigorosa,	Aug. 23,	Aug. 30,	336.4	48.5
Washington,	Aug. 23,	Sept. 5,	404.6	22.7
White Elephant,	Aug. 23,	Sept. 5,	406.1	63.6
White Ohio,	Aug. 12,	Aug. 14,	272.8	48.5
White Peachblow,	Aug. 14,	Aug. 30,	321.2	60.6
Wisconsin Beauty,	Aug. 12,	Aug. 23,	257.6	48.5
Woodbury's White,	Aug. 23,	Sept. 5,	318.2	33.3
Early Andees,*	Aug. 10,	Aug. 14,	509.1	84.9
Early Dawn,*	Aug. 8,	Aug. 12,	509.1	72.7
Salzers' Earliest,*	–	Aug. 8,	434.4	36.4
Triumph,*	–	Aug. 5,	460.7	72.7

* 20 hills only grown.

Thirty-six varieties produce a yield of 55 pounds or over of large potatoes from forty hills when mature, this yield being at the rate of about 333 bushels per acre. These varieties are the following: Burr's No. 1, 351.5; Dutton's Seedling, 363.7; Beauty of Hebron, 393.9; Early Rose, 351.5; Enormous, 397; Fillbasket, 416.2; Howard, 403.1; Late Puritan, 336.4; Leonard Rose, 345.6; Lincoln, 357.6; Montana Wonder, 347; Penn Manor, 339.4; Prolific Rose, 351.5; Reeve's Rose, 345.5; Restaurant, 339.4; Seneca Beauty, 345.5; State of Maine, 333.4; Thorburn, 357.6; Vanguard, 381.8; Vigorosa, 339.4; Washington, 404.6; White Elephant, 406.1; Early Andees,* 509.1; Early Dawn,* 509.1; Salzer's Earliest,* 434.4; Triumph,* 460.7.

Eleven of these varieties gave at the earlier digging 40 pounds or over of large potatoes, which is at the rate of about 240 bushels per acre. These varieties are: Burr's No. 1, 262.1; Dutton's Seedling, 298.5; Beauty of Hebron, 287.9; Early Rose, 263.6; Enormous, 275.8; Howard, 275.8; Montana Wonder, 260.6; Penn Manor, 284.9; Prolific Rose, 257.6; Vanguard, 277.6; Vigorosa, 294.

* Quantity grown less than 40 sets.

There were besides 19 other varieties giving the same or higher yield at the earlier digging. These varieties are: Carmen No. 1, 295.5; Country Gentleman, 251.5; Dreer's Standard, 272.8; Early Kansas, 298.5; Early Roberts, 300; Early Vermont, 266.7; Irish Cobbler, 260.6; King of the Earliest, 265.2; Lakeside Champion, 245.5; Lee's Favorite, 278.8; Maule's Thoroughbred, 260.6; Prince Bismarck, 269.7; Prize Taker, 244; Secretary Wilson, 266.7; Signal, 251.5; Tonhocks, 248.5; Vick's Perfection, 284.9; Victory, P. and W., 278.8; Wisconsin Beauty, 251.5.

It will be noticed that the old Beauty of Hebron and Early Rose are found in both lists, thus ranking still among the most productive sorts, whether for early or late harvest.

There is surely no lack of good varieties of potatoes to choose from, and between many there can be but little difference in value. A single test does not warrant general conclusions. Good northern-grown seed is in my opinion of more importance than name. It is, however, evident that there are a few varieties on our list which seem unworthy of further trial. Among varieties which have made good yields three or more years may be mentioned: Beauty of Hebron, Dutton's Seedling, Early Rose, Enormous, Fillbasket, Prolific Rose, Restaurant, State of Maine, Thorburn, Vanguard and White Elephant.

Experiments in manuring Grass Lands.

The system of using wood ashes, ground bone and muriate of potash, and manure in rotation upon grass land has been continued. We have three large plots (between two and one-half and four acres each) under this treatment. Under this system each plot receives wood ashes at the rate of 1 ton per acre one year; the next year, ground bone 600 pounds and muriate of potash 200 pounds per acre; and the third year, manure at the rate of 8 tons. The system is so planned that each year we have one plot under each manuring. The manure is always applied in the fall, the other materials early in the spring, — this year April 21 and 22.

Plot 1, which this year received barn-yard manure, applied Nov. 16, 1898, gave a yield at the rate of 2.095 tons

of hay and 0.5 ton of rowen per acre; plot 2, which received bone and potash, yielded 2.289 tons of hay and 0.479 ton of rowen; plot 3, which received ashes this year, yielded 1.58 tons of hay and 0.33 ton of rowen per acre. The field has now been eleven years in grass, and during the continuance of the present system of manuring (since 1893) has produced an average product (hay and rowen both included) at the rate of 6,630 pounds per acre. The plots when dressed with manure have averaged 7,027 pounds per acre; when receiving bone and potash, 6,568 pounds per acre; and when receiving wood ashes, 6,294 pounds per acre.

Poultry Experiments.

In experiments completed since our last annual report our attention has been confined exclusively to one point, viz., the comparison of a wide nutritive ration with a narrow ration for egg-production; or, in other words, of a ration in which corn meal and corn were prominent with one in which these feeds were replaced with more nitrogenous foods, such as wheat middlings, wheat and oats. So much greater is the cost of wheat than that of corn, that it seemed desirable to obtain as much evidence bearing upon their relative value for egg-production as possible at an early day. If the latter grain should, on further trial, prove so much superior to wheat as our experiments in 1898 indicated, the knowledge of the fact must prove of enormous value. Accordingly, we reared on the scattered colony plan well-bred pullets of the White Wyandotte, Black Minorca and Barred Plymouth Rock breeds, planning to have two houses (one on each feed) with twenty fowls each of each breed. In introducing purchased cockerels for breeding purposes late in the winter we unfortunately carried contagion, and an obscure form of what is commonly called roup broke out in such aggravated form among the Black Minorcas, that, fearing infection of the fowls in other houses, we killed all the Minorcas. The test with this breed was not, therefore, at all conclusive, and details will not be published. Up to the time the test was closed, however, the corn-fed Minorcas had laid about fifty per cent. more eggs than the others.

General Conditions.

The pullets were first evenly divided into lots of twenty each, being matched in sets of two as closely as possible. Each lot occupied a detached house, including laying and roosting room ten by twelve feet and scratching shed eight by twelve feet, with the run of large yards of equal size whenever weather permitted. The winter tests began October 15 and ended April 22. The hens were all marked with leg bands, as a precautionary measure for the purpose of identification in the case of accidental mixture of fowls.

All the meals and the cut clover were given in the form of a mash, fed early in the morning. At noon a little millet was scattered in the straw with which the scratching sheds were littered. At night the balance of the whole grain was fed (also by scattering in the straw) one hour before dark. The fowls were given what whole grain they would eat up clean. Water, shells and artificial grit were kept before the fowls at all times. About twice a week a small cabbage was given to each lot of fowls, this, like all other food, being weighed. The eggs from each lot were weighed weekly. The fowls were all weighed at intervals of about two months. Sitters were confined in a coop until broken up, being meanwhile fed like their mates.

The prices per hundred weight for foods, upon which financial calculations are based, are shown below : —

Wheat,	$1 60
Oats,	1 00
Millet,	1 00
Wheat bran,	85
Wheat middlings,	85
Gluten feed,	90
Animal meal,	1 75
Cut clover rowen,	1 50
Cabbage,	25
Corn meal,	90
Corn,	90

Narrow v. Wide Ration for Egg-production.

The experiments were in one sense continuous, as the same fowls were used throughout ; but it is deemed best to report the results obtained during the cooler months and those of

the warmer months separately, one being denominated the *winter experiment*, the other the *summer experiment*. These experiments have for their object testing the correctness of the generally accepted view that the laying fowl should receive feeds very rich in nitrogenous constituents (*i.e.*, should have rations with a narrow nutritive ratio). During the tests of the past year corn has been much more largely used than in 1898. Then it replaced about one-half of the oats and wheat usually fed at night; this year the fowls on the wide ration received at night only corn. The fowls on both rations have received cut clover and animal meal in equal proportions.

The health of the fowls on both rations has been uniformly good through both the winter and summer experiments. As last year, however, it is found to require the exercise of more care to avoid overfeeding and loss of appetite among the corn-fed hens.

Winter Experiment.

This experiment, as has been earlier stated, began October 25. This was much too early to make possible the showing of a good record for total eggs, since the pullets did not begin to lay to any extent until January. The facts that they had been at large until the experiment began, after which they were closely confined, and that, as will be remembered, November and December were very cold and stormy, perhaps in large measure account for this. All details necessary to a full understanding of the experiments and the results, it is believed, will be found in the tables: —

Foods consumed, Narrow v. Wide Ration, October 25 to April 27.

KIND OF FOOD.	White Wyandotte.		Barred Plymouth Rock	
	Narrow Ration (Pounds).	Wide Ration (Pounds).	Narrow Ration (Pounds).	Wide Ration (Pounds).
Wheat,	333.00	–	333.00	–
Oats,	55.00	–	60.00	–
Millet,	57.00	56.00	57.50	58.00
Wheat bran,	42.11	42.00	41.30	42.00
Wheat middlings,	42.11	–	41.30	–
Gluten feed,	42.11	–	41.30	–
Animal meal,	42.11	42.00	41.30	42.00
Cut clover rowen,	40.07	40.00	37.80	40.00
Corn meal,	–	111.00	–	111.00
Corn,	–	408.50	–	436.00
Cabbage,	152.38	145.63	152.63	190.75

Average Weights of the Fowls (Pounds).

DATES.	White Wyandotte.		Barred Plymouth Rock.	
	Narrow Ration.	Wide Ration.	Narrow Ration.	Wide Ration.
October 25,	4.3	4.3	4.9+	4.9
January 3,	4.6+	5.0+	5.1	5.6—
March 17,	4.6—	4.7+	5.4—	5.4+
April 27,	4.5—	4.3—	4.9—	4.9+

Number of Eggs per Month, Narrow v. Wide Ration, Winter Test.

MONTHS.	White Wyandotte.		Barred Plymouth Rock.	
	Narrow Ration.	Wide Ration.	Narrow Ration.	Wide Ration.
October,	–	6	11	7
November,	1	7	18	44
December,	9	33	38	44
January,	50	193	27	83
February,	159	228	57	194
March,	213	177	121	216
April,	179	199	112	168
	611	843	384	755

Narrow v. Wide Ration for Egg-production, Winter Test.

	White Wyandotte.		Barred Plymouth Rock.	
	Narrow Ration.	Wide Ration.	Narrow Ration.	Wide Ration.
Total dry matter in foods (pounds),	604.47	635.97	603.13	661.52
Number of hen days, not including males,	3,560	3,560	3,424	3,554
Number of hen days, including males,	3,622	3,622	3,548	3,678
Gross cost of food,	$9 26	$7 30	$9 25	$7 68
Gross cost of food per egg (cents),	1.50	.90—	2.41	1.02
Gross cost of food per hen day (cents),	.26—	.20+	.26	.21
Number of eggs per hen day,	.17+	.24—	.11+	.21+
Average weight per egg (ounces),	1.91—	1.82+	1.76	2.09
Total weight of eggs (pounds),	72.90	95.90—	48.24	98.62
Dry matter consumed per egg (pounds),	.99—	.75+	1.57	.88
Nutritive ratio,*	1:4.80—	1:6.30	1:4.80	1:6.30

* The term nutritive ratio is used to designate the ratio existing between the total nitrogenous and the non-nitrogenous constituents of the feeds used, the former being regarded as a unit, and fat multiplied by 2.5.

Summer Experiment.

The method of feeding during the summer experiment remained the same as in the winter, save in two particulars: (1) in place of cut clover rowen in the mash every morning, lawn clippings in such quantity as the fowls would eat before wilting were fed three times per week to the hens in all the houses the same, and (2) the feeding of cabbages was discontinued. The yards, twelve hundred square feet in area for each house, were kept fresh by frequent use of the cultivator and spade. The health of all the fowls was good throughout this experiment. The tables give all details: —

Foods consumed, Narrow v. Wide Ration, May 1 to September 27.

KIND OF FOOD.	WHITE WYANDOTTE.		BARRED PLYMOUTH ROCK.	
	Narrow Ration (Pounds).	Wide Ration (Pounds).	Narrow Ration (Pounds).	Wide Ration (Pounds.)
Wheat,	273	–	237	–
Oats,	59	–	52.5	–
Millet,	10	10	8	11
Wheat bran,	56	49	40	42
Wheat middlings,	56	–	40	–
Gluten feed,	56	–	40	–
Meat meal,	56	49	40	42
Corn meal,	–	129.5	–	111
Corn,	–	368	–	300

Average Weights of the Fowls (Pounds).

DATES.	WHITE WYANDOTTE.		BARRED PLYMOUTH ROCK.	
	Narrow Ration.	Wide Ration.	Narrow Ration.	Wide Ration.
April 27,	4.50	4.30 —	4.90 —	4.90
June 2,	4.14 —	4.41 +	4.86	4.80
August 11,	4.28	4.68 +	4.88	4.88
September 27,	4.53	4.79	4.70	4.91

Number of Eggs per Month, Narrow v. Wide Ration, Summer Test.

MONTHS.	WHITE WYANDOTTE.		BARRED PLYMOUTH ROCK.	
	Narrow Ration.	Wide Ration.	Narrow Ration.	Wide Ration.
May,	162	181	124	177
June,	140	198	156	217
July,	164	213	140	215
August,	158	213	112	128
September (27 days),	107	110	87	76
	731	915	619	813

Narrow v. Wide Ration for Egg-production, Summer Test.

	White Wyandotte.		Barred Plymouth Rock.	
	Narrow Ration.	Wide Ration.	Narrow Ration.	Wide Ration.
Total dry matter in foods (per cent.),	510.41	534.22	412.44	446.35
Number of hen days, not including males,	2,945	2,913	2,400	2,555
Number of hen days, including males,	3,245	3,213	2,573	2,735
Gross cost of food,	$7 50	$5 86	$6 14	$4 91
Gross cost of food per egg (cents),	1.03	.64	1.00	.60
Gross cost of food per hen day (cents),	.23	.18 +	.24	.18
Number of eggs per hen day,	.25 —	.31 +	.26 —	.32 —
Average weight per egg (ounces),	1.88	1.90	1.82	1.77
Total weight of eggs (pounds),	85.89	108.70	70.40	89.94
Dry matter consumed per egg (pounds),	.70	.58	.67	.55
Nutritive ratio,*	1:4.20	1:6.30	1:4.40	1:6.30

* The term nutritive ratio is used to designate the ratio existing between the total nitrogenous and the total non-nitrogenous constituents of the feeds used, the former being regarded as a unit, and fat multiplied by 2.5.

It will be seen that the results of this year's experiments are in every particular similar to those of the experiments carried out in 1898.

The following are the most essential facts : —

1. The wide (rich in corn) ration appears to be much superior to the narrower ration. In all experiments, both summer and winter, the hens receiving corn have laid many more eggs than those receiving wheat.

2. The differences this year in favor of the wide ration, upon the basis of an equal number of hen days, are as follows : —

White Wyandotte, winter test,	41 per cent.
White Wyandotte, summer test,	24 per cent.
Barred Plymouth Rock, winter test,	91 per cent.
Barred Plymouth Rock, summer test,	23 per cent.
Last year the winter difference was	25 per cent.
Last year the summer difference was	$33\frac{1}{3}$ per cent.

3. The total cost of feeds was less for the wide ration, and of course the cost per egg was much less. In the production of one dozen eggs the saving amounted to from $4\frac{2}{3}$ to $16\frac{3}{4}$ cents.

4. The fowls on the wide ration gained more in weight than the others. Although laying many more eggs, they averaged at the end of the summer test nearly one-quarter of a pound each more than the others.

At the close of the summer experiment the fowls were most critically examined by a number of different parties, working independently, and all were unanimous in the conclusion that the corn-fed hens were farther advanced in the moult than the others. In my own opinion, the difference amounted to some two or three weeks in time. The corn-fed hens had shed all their old tail feathers, the others but few; the corn-fed hens had a large share of their new body feathers, the others had not shed the old. It was evident that the corn-fed hens were sure to begin laying again before the cold weather, while it seemed that the others were unlikely to do so. This judgment has been verified, for a small number of the corn-fed hens which were purchased by the writer have already laid one litter of eggs since October 1 and are beginning to lay a second, their plumage having been perfect for many weeks (December 20).

The great importance of an early moult in case hens are to be kept over is recognized by all. It makes all the difference between profit and a probable loss.

Our results with both breeds, both summer and winter, are thus greatly in favor of the ration richer in corn meal and corn. On its side we have: (1) lower cost of feed; (2) from 23 to 91 per cent. more eggs; (3) a far lower cost per egg, making possible a saving of from $4\frac{2}{3}$ to $16\frac{3}{4}$ cents per dozen in the food cost of their production; (4) a greater increase in weight; and (5) a much earlier moult.

It may here be remarked, using the words employed by the writer in a recent article, "that nature is generally a safe guide; 'Biddy,' kept healthy and vigorous, will take corn always in preference to wheat. Man conceived the idea that wheat is better for large egg-production. He has been endeavoring to convince the hen that she doesn't know what is good for her; and now it seems that, after all, her instinct and not his supposedly scientific reasoning has been right."

The writer is aware that under different conditions other results might follow. It is here particularly pointed out that our fowls are given plenty of space and fresh air, and that they are made to scratch vigorously for their whole grain.

REPORT OF THE BOTANISTS.

G. E. STONE, R. E. SMITH.

The work of this division has gone on steadily during the past year, having been almost entirely along the line of vegetable physiology and pathology. A large amount of correspondence has been carried on, along with the work of investigation. A considerable part of the work has been in connection with the growing of green-house crops, as in past years, lettuce, cucumbers and tomatoes receiving especial attention. The investigations outlined in our last report have been continued, and results obtained which in several cases are nearly ready for publication. The only entirely new subject of importance which has been taken up is that of aster diseases, which is referred to more fully later in this report. A bulletin on "The asparagus rust in Massachusetts" has been issued, containing the results of the investigation of this subject up to 1899. A further consideration of the same subject will be found in the present report.

Aster Diseases.

General complaint has been made of late years in all parts of the country of the trouble in growing asters, and at present more or less complete failure is almost universal. We have therefore commenced an investigation of this subject, with a view to ascertaining the exact nature of the trouble, and what may be done to prevent it. A large number of asters were grown during the past season, and, with the experience already gained, it is planned to grow many more next year, under various conditions which have suggested themselves as bearing on the trouble. Some valuable in-

formation has already been obtained, and it is hoped that another season's experience will afford considerable insight into the difficulties which now bid fair to prevent the raising of this popular and valuable flower.

Some Prevalent Diseases of the Year.

The following are some rather uncommon diseases which have been unusually prevalent during the past season: —

The Bacterial Cucumber Wilt.

In our last report we gave an account of a wilting of cucumber leaves, due to purely physiological causes. A disease of the same plant, and having a very similar effect, but caused by bacteria, is well known, and appeared in this vicinity in out-of-door cucumbers this year. In this case the bacteria which cause the trouble develop mostly in the ducts of the stem and leaf petioles, multiplying rapidly, and causing a stoppage of the flow of sap and hence a wilting of the leaves. The organisms can be readily seen, oozing out in little drops from the cut ends of affected parts. Pure cultures may be easily obtained from these drops.

No remedy can be given as yet for this disease, other than the removal and burning of affected plants.

A Geranium Disease.

In our annual report for 1897 we described a leaf-spot disease of the cultivated geranium (Pelargonium), which was thought to be caused by bacteria. It appeared at that time in a very wet season, and seemed more a result of the abnormal conditions than a true disease. The same trouble has been abundant during the past season, however, and appears to be a dangerous enemy to the growth of this plant. It causes small yellow and dead spots in the leaves, so that they fall off, and the plant becomes nearly denuded in the worst cases. Examination showed, as before, that the dead spots are full of bacteria, and no other organisms could be found, the former appearing to be the cause of the disease. Attempts were made to isolate the organisms, but

thus far without success; apparently it does not flourish under ordinary culture methods and conditions. Nevertheless, we have here, to all appearances, a genuine bacterial disease.

No remedy can be given for this trouble, beyond good cultivation and the production of vigorous plants. Cases have been seen where affected plants lost most of their leaves and produced a new crop, the latter more or less diseased, but still sufficient to present a fairly good appearance. The use of fungicides has no apparent value in such a case as this.

Muskmelon Failures.

Much complaint has been heard during the past season in this and other States of trouble with muskmelons. In our last report we described a disease of this plant caused by a fungus (*Alternaria*). The disease appeared again this year in the same and other places, and some weeks earlier than before, so that spraying experiments which we had planned were begun too late to be of value. Besides this disease, the common anthracnose (*Colletotrichum lagenarium* (Pass.) E. & H.) has been abundant, and very destructive both on muskmelons and watermelons. We saw one field of watermelons of unusually fine appearance completely ruined by this disease within a week. The stems and fruit were the parts most affected. There is every reason to believe that the Bordeaux mixture can be used with profit in these cases; but our experience this year has shown that if the treatment is not begun by July 1 or earlier, before any sign of disease has appeared, it will be entirely useless.

The Maple Leaf Blight. (*Phyllosticta acericola C. & E.*)

This disease, which affects several species of maple, has been known for some time, but has been much more abundant than usual during the past season. We have received it on sugar maple from several different parties. Large dead spots are produced in the leaves, which become curled and distorted, losing all beauty. Beyond this the actual injury to the tree is probably in most cases very slight.

The Chrysanthemum Rust.

This disease, which we first reported in 1897, appears to be on the decline in Massachusetts. It has been quite common the past season in various places, but in most cases has caused no apparent damage.

Some Experiments in growing Violets in Sterilized Soil.

Some experiments have been made this last year with violets, for the purpose of determining the relation between the production of flowers and the occurrence of leaf spots in sterilized and unsterilized soil respectively. For this purpose cuttings were made in the spring from mature plants and put into sterilized sand, after which they were transplanted into sterilized soil and removed out of doors, where they remained during the summer. In the fall they were transferred to the house and planted in a bed divided equally into two sections, each of which consisted of garden soil of good quality. One section of the bed was sterilized and the other section was not, and, in addition to this, the latter was inoculated with the parasitic nematode *Heterodera*. It should be stated, however, that the nematodes were not abundant enough in the inoculated soil to do any harm, as the bed was inoculated some time previous to setting out the violet plants, and, as no host plants were present, they died, or at least they did not gain any foothold upon the violets. The experiment is therefore largely one between sterilized and unsterilized soils.

Sterilizing the soil alone gives rise to beneficial results in the growth of a crop, a fact which we have already called attention to in Bulletin 55, issued from this station, and various experiments on different crops since has demonstrated the same thing.

Both of the beds were under tolerably equal conditions, at least so far as light and moisture were concerned; but a ventilator made some difference in the growth of a few plants in each section. The total number of plants employed in this experiment was fifty-four, and were of the variety known

as the Schœnbrun, which is not especially noted as a flower producer.

The following table shows the results of the experiment:—

Table showing the Monthly Production of Violets in Sterilized and Unsterilized Soil.

DATE.	Number of Blossoms picked.		Percentage of Gain.
	Unsterilized Soil.	Sterilized Soil.	
November,	19	38	100
December,	62	101	63
January,	55	125	127
February,	39	72	84
March,	144	250	73
April,	482	510	5
Total,	801	1,096	–
Average,	133	182	36

The results in the preceding table show a considerable increase in the production of blossoms as a result of sterilizing the soil. The percentage of gain of the sterilized plat over that in the unsterilized was 36. It will be observed also that the gain in flower production in general was most marked during the first half of the experiment, and the flower production falls off in the sterilized earths in the succeeding months, until in April, when the experiment was discontinued, the gain was only 5 per cent. over that of the unsterilized. The maximum occurred during the third month (January), although this might not occur in every instance, as a large number of experiments would probably modify these results.

Observations were made in regard to the number of leaf spots in the two plats, with the result that the sterilized plats gave the smallest number, hence showing that vigorous plants are less susceptible to fungi.

The methods employed in sterilizing the soil were the same as those described on page 54 in Bulletin 55, from this station.

In regard to the practice of sterilizing soil for the purpose

of growing plants, we will state that, while there is no doubt as to the beneficial results obtained by sterilizing the same soil for two or three crops, it does not necessarily follow that soil will repeatedly stand this treatment and give good crops.

Within the last year sterilized soil has been recommended for home culture purposes, and those who use it claim to have obtained superior results.

The Relationship existing between the Asparagus Rust and the Physical Properties of the Soil.

The past season has been most favorable to the outbreak of the asparagus rust, which has manifested itself in a severe manner in the same localities where it has occurred during the last few years. The unusually dry spring enabled us to predict to asparagus growers the probable occurrence of the rust for last summer; and, as the rust has usually shown itself the season following an outbreak, regardless of the weather conditions, we may expect to encounter the same next summer (1900), at least in those beds which were badly affected and weakened from the attacks of 1899. We have endeavored to point out in Bulletin 61, issued from this station, the relationship existing between dry seasons and the occurrence of the summer or injurious stage of the rust, and also the susceptibility of plants growing in localities possessing soil with little water-retaining properties. Our observations and experiments during the past season have not led us to reverse any of the conclusions set forth in this bulletin, but, on the other hand, we are more strongly convinced of their validity. These conclusions are based upon an extensive study of the localities affected, and the object of the present article is to call attention to additional data relating to the distribution of the rust in Massachusetts, and the relationship existing between the outbreak of the rust and the rainfall, together with the physical properties of the soil. For the past three seasons we have paid attention to the distribution of the rust in Massachusetts, although the regions infected during the past summer (1899) scarcely differ from those infected during previous years.

Attention was first called to the asparagus rust in the fall of 1896. During 1897, although an extremely wet season, the damage by the rust was severe. Its occurrence during this season, however, was merely an after-effect, the primary cause being due to the injury caused by the preceding dry seasons. In 1898 the summer stage of the rust was scarcely perceptible; while in 1899 (the past season) the rust was severe, on account of the want of soil moisture.* The fall stage of the rust (black or teleuto spore stage), which is, according to our estimation, a harmless stage, and not worth paying much attention to, has been universally distributed over the State since 1896. There has, however, been some tendency for it to become less common during the last two years. This stage usually occurs during September and October, about the time when the asparagus plants first commence to lose their green color and turn yellow, the appearance of this stage being associated with the disintegration and death of the plant. The summer stage of the rust (red or uredo stage), which is in every instance an injurious stage, occurs during July and August. It occurs about July 11, or later, on beds from which a crop has been marketed, and spreads very rapidly with the wind, as is evident by those sides of the asparagus plant being first infected which correspond with the prevailing direction of the wind. We have no data as to any earlier appearance of the rust on young plants which have not been cut for the market, and it would not be at all improbable that they become infected earlier than July 11. The summer stage of the rust, however, is limited in its distribution in Massachusetts, and is found only on those soils which are sandy, and possess little water-retaining properties. The sand increases as we approach the sea-coast, and the soils which support asparagus plants affected with the red rust are found with some local exceptions in the eastern part of the State.

The summer stage of the rust has never been observed by us, nor has it been reported (with one exception, which we will refer to later, and which is local) any further west than the towns of Berlin and Northborough, which are east of the

* The amount of rainfall from April 1 to September 1 in 1899, at Amherst, was 14.09 inches; that for the same period in 1898 was 23.97 inches.

meridian 71° 40′. (See map.) These towns would appear to be on the border zone of the uredo spore outbreak, and the occurrence of the rust here is by no means so universal as it is in the sandier region of Cape Cod. Some of the growers situated upon the border zones of infection may have the summer stage badly one season and the next season be free from it. The soil of this region offers sufficient differences in texture from the more sandy coast soils, so that sound, vigorous plants might be expected to be proof against the rust in any season, and the outbreak here might be largely prevented by careful cultivation and feeding of the plants.

An examination of the map (fig. 1) will show those portions of Massachusetts in which the summer stage of asparagus rust has appeared up to the present time. The only region infested with this stage of the rust in Massachusetts west of the meridian 71° 40′ is in the Connecticut valley, in the vicinity of Montague, where the soil is remarkably sandy and dry, while other portions of the Connecticut valley which possess more or less heavier soil have been entirely free from this stage. The affected area shown on the map is characterized by a loose sandy soil, which possesses less water-retaining properties in most instances than the soils of their immediate vicinity. In order, however, to show more definitely the differences existing between the texture of the soils of the eastern part of the State and those of the central and western parts, we have made a number of mechanical analyses of the soils of various regions, which include many from the infected asparagus fields. Any one who has paid special attention to our Massachusetts soils and their influence upon the development of plants would not require a mechanical analysis in order to become convinced of the differences existing between them, as a glance at the soils in the field would be sufficient. Nevertheless, a mechanical analysis will show us the exact differences existing between the textures of the soil of the various regions, and we will moreover be able to demonstrate the amount of difference exhibited in their water-retaining capacity. The following table gives the data of the mechanical analysis*

* The methods of analysis employed are those of Prof. Milton Whitney.

of ten typical surface soils from various parts of the State between the Cape and the New York State line : —

TABLE I. — *Showing the Mechanical Analyses* * *of Ten Massachusetts Soils, extending from Cape Cod to Western Massachusetts. — Average Percentage of Organic Matter, Gravel, Sand, Silt and Clay in 20 Grams of Soil.*

[Diameter of the grains in millimetres (1 millimetre equals about 1/25 inch) : gravel, 2–1 ; coarse sand, 1–.5 ; medium sand, .5–.25 ; fine sand, .25–.1 ; very fine sand, .1–.05 ; silt, .05–.01 ; fine silt, .01–.005 ; clay, .005–.0001.]

SAMPLE.	Water.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
Orleans,	1.82	2.20	20.97	31.03	19.70	12.26	6.26	2.77	1.46	1.37
Bridgewater,	1.86	2.10	17.92	28.80	18.85	5.80	19.15	2.85	1.34	.66
Eastham,	1.66	2.00	9.38	27.91	25.09	21.43	8.70	1.40	.77	1.43
Concord,	1.66	4.19	4.24	10.20	12.81	27.93	34.11	1.84	1.73	1.08
Attleborough,	8.13	7.64	9.26	11.15	7.87	11.53	29.50	10.95	2.51	1.42
Worcester,	3.00	9.40	1.65	2.80	4.25	19.85	42.95	4.50	2.95	2.75
Spencer,	3.40	9.80	2.70	4.55	7.30	22.35	29.60	6.65	2.45	3.25
Montague,	.90	1.86	.27	4.39	19.85	43.88	25.75	2.63	.36	.27
Amherst,	2.98	7.31	.95	1.25	1.72	7.28	66.19	6.96	1.33	4.13
Pittsfield,	9.50	11.25	5.50	5.95	5.02	13.87	36.15	6.45	.87	5.40

* Analyzed by A. A. Harmon and Asa S. Kinney.

The first six soils represent typical samples taken from affected fields in locations where the summer stage of the rust has always been present since its occurrence in Massachusetts, and in most instances where it has been severe. The other samples are from towns which have not shown the summer stage of the rust, but in which the fall stage has occurred. All of the samples are so-called surface soils, and represent single analyses. Except in the Amherst soils they represent an average of four analyses, while in the Pittsfield there is an average of two. A careful examination of the table will show considerable difference in the texture of the soils of the various regions. It will be observed that the coarse elements are much more common in the coast soils than in the inland soils, and conversely that the fine elements are greatly increased in the inland soils.

In order to obtain a better idea of the relative amounts of the various constituents found in the different soils, we can arrange them as in Table II., in which the average constituents contained in the four coast soils are shown alongside of four inland soils which are characteristic of the central and western regions of Massachusetts. The four coast soils represent badly infested regions, while the four inland soils represent those in which only the fall stage has occurred.

TABLE II. — *Average Percentage of Organic Matter, Gravel, Sand, Silt and Clay in Orleans, Eastham, Concord and Bridgewater (Coast Soils), and Worcester, Spencer, Amherst and Pittsfield (Inland Soils).*

SAMPLE.	Organic Matter.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt.	Fine Silt.	Clay.
Four coast soils, ...	2.62	13.12	24.48	19.11	16.85	16.80	2.21	1.32	1.13
Four inland soils, ...	9.44	2.70	2.63	4.57	15.83	18.72	6.14	1.90	3.88

The largest amount of gravel as shown by the table is in the Orleans soil from Cape Cod, which is 20.97 per cent.; the average for the whole is 13.12 per cent., against 2.70 per cent. for the inland soils. What holds true in regard to the gravel is also true when we consider the coarse sand, where the proportion is 24.48 per cent. in the coast soil, to 2.63 per cent. in the inland soils; while in the medium sand it is 19.11 per cent. to 4.57 per cent. Only slight differences are shown in the proportion of fine and very fine sand between the two regions, although the coast soils are ahead in the former and the inland in the latter; whereas in both of the silts and clay the largest amounts are found in the inland soils. If we turn to the organic matter, we find that it is also more abundant in the inland soil than it is in the coast soil. This difference is partly accounted for by the fact that some of the samples of inland soil represent highly manured soils, adapted to intensive cultivation. Even making allowances for this fact, the organic matter would seem higher in the inland soils than in the coast soils, inasmuch as various samples of soil

taken from inland localities which were not manured gave an average of about 6 per cent., or about three times as much as that shown by the coast soils. This is not true, however, of the coast soils such as are used for general truck farming, — as in the case of Arlington, for example, — in which instance we would find the percentage of organic matter quite large. The amount of water in the soils differs also, which is caused by the analyses of some of the samples being taken at different times, and from not being subject to the same air-drying conditions. It will also be noticed that the Attleborough soil contains an unusually large amount of silt, — a feature which seems to be peculiar to that soil alone. As a rule, the inland soils contain a very large amount of very fine sand, and this appears to be especially characteristic of the Connecticut valley soils. Some analyses which we have made show that this soil sometimes possesses as much as 75 per cent. of this constituent. It is the excessive amounts of this constituent of the soil which renders the Amherst soil compact, and which gives to it an increased water-retaining capacity. The clay, however, shows a gradual increase as we pass inward, and in a less uniform manner is this exhibited by the silt, which can be seen by examining Table III.

TABLE III. — *Showing the Percentage of Gravel-Sand, Silt and Clay in the Soils shown in Table I.*

SAMPLE.	Gravel-Sand.	Silt.	Clay.
Orleans,	90.22	4.23	1.37
Bridgewater,	90.52	4.16	1.13
Eastham,	92.51	2.17	1.43
Concord,	89.35	3.57	1.08
Attleborough,	69.39	13.46	1.42
Worcester,	71.50	7.45	2.75
Spencer,	66.50	9.10	3.25
Montague,	94.15	2.99	.27
Amherst,	77.39	8.29	4.13
Pittsfield,	66.49	7.32	5.40

There are inland soils which contain considerable amounts of sand, such as the Connecticut valley soils, for example,

thus offering exception in this respect to the surrounding localities. The Montague soil is one of these, and it will be noticed by examining Table III. that the percentage of sand is very high in this. It is not, however, the coarser varieties but the finer which predominate, thus differing widely from the sandy soil of Cape Cod. Notwithstanding this variation, a large number of analyses show that the clay appears to follow, as a rule, what might be termed a normal amount for each particular region. It is therefore interesting to note in this connection that the increase of clay as we pass inward is fully as characteristic and uniform in the Massachusetts soils as is the decrease of the sand. The differences existing between the texture of the coast and inland soils are sufficient to exert considerable influence upon the growth of plants. This difference is equally perceptible, whether we see the soils in the field or in a table showing their analyses.

Having paid some attention to the physical properties of a few of our State soils, and their effect upon plant development, we are able to ascertain approximately from a mechanical analysis the characteristic properties of the constituents, and what effect they exert upon the development of certain crops. As a rule, we can divide the various constituents directly in the middle; that is, we can consider the four coarser elements and the four finer constituents by themselves. Such an arrangement of the soils is shown in Table IV.

Table IV. — *Showing Soils as in Table I., arranged according to the Percentages of Gravel and Coarse, Medium and Fine Sand, the Very Fine Sand, Silt and Clay being omitted.*

Orleans, ...	83.96	Attleborough, . .	39.81
Eastham, . . .	83.81	Spencer, ...	36.90
Bridgewater, . . .	71.37	Pittsfield, . . .	30.34
Montague, . . .	68.39	Worcester, . . .	28.55
Concord, ...	55.18	Amherst, . . .	11.20

If, for example, a soil is rather low in the constituents represented by the gravel and coarse, medium and fine sand,

and correspondingly high in the remaining constituents, then we possess a soil which is characteristic of the inland types, and will pack down very closely when wet. If, however, the reverse of this is true, we find a loose, pliable soil, such as is found on the coast, which is easily worked and especially adapted for truck farming. The latter soil will not retain much water, it quickly dries out; while the former or inland soil will retain considerable water for a long time, inasmuch as the resistance and relative amount of water maintained by different soils depends upon the volume of space in the soil for the water to enter, which in turn depends upon the number of grains of sand, silt and clay. In sandy soils the space is not divided up as much as in a clay soil; the grains of sand being larger, the spaces between the grains are also larger, there is less friction, and the water moves downward more quickly. The order of arrangement of the soils in Table IV. (which is that relative to the coarse material they contain) follows very closely the water-retaining capacity of the soils, as we shall see when we come to Table V.

These are in part the principal differences existing between the coast and inland soil, with now and then an exception; and the outbreak of the summer or injurious stage of the asparagus rust is always characteristic of those soils which are sandy and porous, and consequently possess little water-retaining capacity, whether they are located near the coast or inland. It should, however, be borne in mind that it is not the percentage of coarse and fine material alone which is responsible for the character of a soil, but the shape and arrangement of its particles exert an influence upon it. Then, again, the organic matter, the depth of the soil and the nature of the sub-soil, as is well known, are important when the question of moisture and dryness is concerned. We have already pointed out that the four soils from the coast contain less organic matter than those from inland soils, and this fact holds good for the Montague sample also. If these soils were richer in organic matter, their water-retaining properties would be increased, and they would become less susceptible to the rust.

In order to test the water-retaining properties of some of these samples of soil, we subjected them to the following

treatment. Three hundred grams of the air-dried soils were taken and put into a cylinder three inches wide and six inches high, with a perforated bottom, over which there was placed a layer of filter paper. The cans containing the soil were then weighed, after which the samples were liberally treated with water until they contained all that was possible for them to hold. The cylinders were then set aside, and after the water had stopped dripping they were again weighed, and the additional weight which was due to the amount of water applied was noted. This represented the amount of water which the soils could retain. Other air-dried samples of the same soil were heated in an oven to perfect dryness, and by this means the amount of hygroscopic water was obtained for each. This, being added to the amount of water retained, gave the total water capacity of the soil; and, dividing this sum by the weight of water-free soil, which was obtained by subtracting the hygroscopic water from the original three hundred grams, we obtain the percentage of water which each soil is capable of retaining; or, in other words,

$$\frac{\text{Water retained} + \text{Hygroscopic water}}{\text{Water-free soil}} = \% \text{ of water-retain-}$$

ing capacity.

The following table gives the results of these experiments in the order of water-retaining capacity: —

TABLE V. — *Showing the Retentivity of Soil Moistures in Order of Retaining Capacity.*

SAMPLE.	Water retained (Grams).	Hygroscopic Water (Grams).	Weight of Water-free Soil (Grams).	Percentage of Water retained.
Orleans,	103.0	2.10	297.90	35.28
Bridgewater,	99.5	.66	299.34	37.13
Eastham,	115.9	.78	299.22	38.99
Montague,	144.8	.90	299.10	48.71
Concord,	145.3	2.76	297.24	49.81
Attleborough,	168.9	4.20	295.80	58.52
Amherst,	200.6	2.82	297.18	68.45

As might be expected, the coast soils show the smallest percentage of water-retaining capacity, and this percentage

increases as we pass inland to the heavier soils, as would naturally follow. The smallest percentage is shown by the soils from Cape Cod, where there is a considerable amount of coarse material and small amounts of fine material; while the largest percentage is given by the Amherst soil, which contains a larger amount of fine material and a less amount of coarse material than the coast soils. The Amherst soils show 68.45 per cent. water-retaining capacity, against 35.28 per cent. for the Orleans; or, in other words, the Amherst soil possesses nearly twice the water-retaining capacity of the Orleans soil. Only two determinations were made of the water-retaining properties of the soil west of Worcester, one being at Montague, where the summer stage of the rust is present, and the other at Amherst, where it has never occurred. These two determinations are, however, sufficient for our purpose; inasmuch as the preceding table shows that the water-retaining properties of the soil decrease in loose, sandy soil, and increase in fine, compact soil; and, as the mechanical constituents of such soils as the Worcester, Spencer and Pittsfield are larger in fine material and more closely resemble the Amherst soil than those of the coast, we would therefore find similar water-retaining properties.

The cans containing the soils were left in a room of even temperature, and after five days had elapsed they were weighed again, with the following result: —

Table VI. — *Percentage of Water lost by the Following Soils after Five Days.*

Bridgewater, ...	75.07	Attleborough, . . .	46.95
Orleans, ...	73.78	Montague, ...	40.33
Eastham, ...	66.17	Amherst, ...	23.33
Concord, ...	51.75		

These results follow in a general way those shown in Table V. The Bridgewater, however, lost slightly more than the Orleans. As most of these soils were gathered within a few days of. each other, it may be of some interest to note the amount of water found in each at the time the samples reached the laboratory. Amherst gave 33.60 per cent. of

water; Montague, 11.26 per cent.; Orleans, 12.50 per cent.; Attleborough, 15.40 per cent.; Concord, 8.65 per cent.; Eastham, 5.69 per cent.; Bridgewater, 3.74 per cent. These figures do not possess any great value, but in a general way they correspond with those in the preceding table. The variation in the amount of rainfall in different parts of the State of course comes into account here. We will state, however, that the Amherst soil referred to was taken from an asparagus bed which has never had the rust in any stage, — a fact which is not only due to its characteristic texture and the nature of the subsoil, but to the fact that the plants have been thoroughly cultivated and properly fed, and consequently are in a very vigorous condition. According to Professor Brooks, this bed has at times received a heavy dressing of cow manure in the fall, which has been forked in in the spring, and then fertilizer has been put on at the following rate per acre: muriate of potash, 600 pounds; nitrate of soda, 200 pounds; and acid phosphate, 900 pounds.

Asparagus growers have stated that there is a difference as to infection in different parts of a field. Many have stated that the drier places were the most badly infested, while others could notice no difference, or in some instances those parts which they considered the least dry showed the rust the worst. This latter condition does not in any way affect our conclusions that the rust (summer stage) is peculiar alone to those regions that possess sandy soil which has little water-retaining capacity, inasmuch as our conclusions are general, and refer to the State as a whole. That exceptions do occur even in a single bed is not at all strange, so long as plants are endowed with a tendency to vary. There are other factors which have a bearing on the susceptibility of plants to rust other than those of soil and water conditions, among which is the general health condition or vigor of the plant. We have repeatedly observed in the same bed numerous plants that were badly infected, while directly beside them were some which were perfectly healthy. We do not maintain, however, that, in a bed where the plants possess the same amount of vigor and where they are under exactly similar conditions except in regard to moisture, those in the dry place will succumb to the rust quickest and become more

severely affected than those located in dry places. The principal feature which we wish to emphasize in connection with these experiments is that the summer stage of the asparagus rust is due to a weakened condition of those plants growing on dry soil during seasons of extreme drought. In other words, the plants suffer for water; and, since this is the case, the rational method of prevention must take the amount of soil moisture into consideration. It will not be out of place here to reflect upon the present status of the rust problem, and consider the methods which should be employed in our endeavors to control it.

The practice of spraying, it would seem, is not likely to give promise of any remarkable results, because the asparagus plants offer difficulties in this respect, and all of the rusts are hard to control. Stewart found, in his experiments on spraying for the carnation rust, which attacks a host largely confined to greenhouses and therefore much better under control, that the best results obtained by spraying were not very promising. Then, again, it is possible that the asparagus rust mycelium may be confined to the plant throughout the year, in which case the value of spraying would be practically useless. We have observed a fungous mycelium in the roots and stems of the asparagus plants below the ground long before any occurrence of the rust showed upon the aerial stems; but whether the mycelium was identical with that of the rust, or of other parasitic fungi frequently found upon the asparagus, we were not able to ascertain. We must therefore turn our attention to other methods of control, — to methods which will enable us to keep the plants under more normal conditions during seasons of drought. These methods will consist, first, of securing the most vigorous plants, — a feature which is dependent upon cultivation and the proper kinds and amounts of plant food with which the plants are supplied. There is considerable difference in the plants of various growers in this respect; the most vigorous and largest plants which we have observed were situated in a dry region, subject to uredo infection, but they have never suffered from the rust till this season. The amount of rainfall between April 1 and September 1 of this year has been the lowest for many years, and many beds have shown the summer stage for the first time this year. It is interesting

to note, however, that cultivation and skilful plant feeding alone have enabled some beds to suppress the outbreak of the summer stage.

Then, again, the question of soil moisture during dry seasons must be considered. There are different ways of securing this, such as by irrigation, by increasing the organic matter in the soil, or by mulching. In selecting a site for new beds, they should be started on soil possessing some degree of water-retaining capacity, even if such soil is not adapted quite so well for asparagus during ordinary seasons. We are convinced, however, that soils such as the Montague and Attleborough, which appear to be good asparagus soils, possess enough fine material and sufficient water-retaining capacity to prevent the summer outbreak, provided robust plants are secured. In fact, we are informed that the summer stage of the rust has not appeared on the beds at Attleborough from which this sample was taken previous to this year. It is these extremely light, sandy soils that have been selected for the largest asparagus beds, because they appear to be best adapted for its growth. Numerous inquiries from towns adjoining many of these badly infected regions have failed to show any evidence of injuries from the rust, as the texture of the soil is slightly different.

If the asparagus rust continues to cause as much injury in the future as it has in the past, it may become necessary to resort to those soils of a finer texture for the cultivation of this crop. The matter of irrigation would be expensive and not readily resorted to on many beds, while others that we know of could be very easily irrigated by damming a small stream and properly diverting the course of the water. Since the asparagus rust is brought about by drought, and is therefore not likely to cause much injury except during such seasons, the occurrence of the disease can be anticipated. In this respect it differs from other common plant diseases, inasmuch as we have to spray for them every season, whether we know they are going to make their appearance or not. An annual treatment would therefore not be required. It is hoped that some preventive measures, based upon the retentivity or the supplying of soil moisture, will be employed by those growers who are favorably situated and who have suffered from the rust.

REPORT OF THE METEOROLOGIST.

JOHN E. OSTRANDER.

The work of this division the past year has been principally devoted to the observation of the various weather phenomena, together with the reduction of the records and their arrangement in form for preservation.

The usual monthly bulletins, giving the more important daily records and a review of the character of the weather, have been issued, and the annual summary will be published as soon as the records for the year are complete.

Throughout the year the New England section of the United States Weather Bureau has furnished us daily, except Sunday, with the local forecasts of the weather, and the signals have been displayed from the top of the tower. Arrangements have been made to furnish them the weekly snow reports, as heretofore.

The observations relating to soil temperature and moisture by the electrical method, begun two years ago, have been continued this year. Owing to the unsatisfactory results of the previous years, the temperature cells and moisture electrodes were tested and standardized before using them in the field. The temperature cells were placed in water and the resistances observed. After the resistances became constant for each cell, the temperature of the water was taken by a standard thermometer. The resistance of each cell was thus determined, for temperatures varying by about 10° F., for a range exceeding that which it would be subjected to in the field. The cells were afterward placed in soil in a box, and the resistances observed and the temperature computed by the tables in Bulletin No. 7 of the United States Department of Agriculture, Division of Soils, and checked by using a standard thermometer. The standardization of the moisture

electrodes was effected by placing them in soil in boxes so arranged as to provide for a proper diffusion throughout the soil of water as added, taking the resistances and computing the percentage of moisture from the weight. When afterward used in the field these electrodes gave more satisfactory results than had before been attained. The results for the corn-growing season of the current year have been worked out. The observations will be continued next year, for purposes of comparison.

The means of the various weather elements for each month and year, for the ten years from 1889 to 1898 inclusive, have been tabulated, and normal conditions for the period deduced. These results are of especial interest for the purpose of noting departures from normal conditions. The tabulations, together with other data of interest, will be found on the following pages.

Meteorological Observatory of the Hatch Experiment Station, Massachusetts Agricultural College, Amherst.

General Summary, 1889–98.

Latitude of observatory, 42° 23′ 48.5″ N.; longitude, 72° 31′ 10″ W. Elevation of ground at base of observatory above mean low water, Boston harbor, 223 feet, as determined by levels connecting with those of the Boston & Maine Railroad. The standard barometer is 50.5 feet above the ground and 273.5 feet above sea level. The Draper self-recording barometer is 51.5 feet above ground. The cup anemometer, pressure anemometer, anemoscope and sun thermometer are located on top of the tower, 72 feet above the ground. All temperatures are taken in the thermometer shelter on the campus, about 4 feet above ground and 220 feet above sea level. The standard rain gauge is on the campus, about 2 feet above the ground and 218 feet above sea level.

Mean Barometer.

[Readings are reduced to freezing and sea-level.]

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean Annual.
1889,	30.113	30.238	29.843	29.795	29.916	29.960	29.909	30.008	29.999	30.050	30.040	30.139	30.001
1890,	30.191	30.097	29.993	30.098	29.959	29.975	30.019	30.001	30.124	29.880	30.007	30.013	30.030
1891,	29.958	30.041	30.099	29.923	29.983	29.919	29.986	29.965	30.114	30.028	30.117	30.081	30.018
1892,	29.965	30.106	29.895	29.972	29.943	29.923	29.988	30.017	30.103	29.896	29.988	30.010	29.983
1893,	29.951	30.111	30.065	30.086	29.895	30.056	29.968	30.001	30.065	30.126	30.124	30.120	30.047
1894,	30.175	30.160	30.088	30.054	30.000	29.997	30.012	30.033	30.143	30.016	30.081	30.148	30.085
1895,	30.047	29.918	29.998	30.119	30.097	30.172	30.031	30.016	30.097	30.082	30.187	30.151	30.076
1896,	30.158	29.860	29.990	30.143	29.984	29.949	29.974	29.989	30.004	30.011	30.145	30.135	30.028
1897,	30.041	30.056	30.036	30.042	29.924	29.901	29.943	29.943	30.091	30.122	30.034	30.036	30.014
1898,	29.976	30.052	30.203	29.927	29.937	29.947	30.017	29.959	30.012	30.089	30.010	29.963	30.008
Mean,	30.057	30.064	30.021	30.016	29.964	29.980	29.985	29.993	30.075	30.030	30.073	30.080	30.029

Range of Barometer (in Inches).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Range.
1889,	1.62	1.51	1.58	1.16	.75	.97	.68	.66	.98	.96	1.31	1.75	1.81
1890,	1.50	1.35	1.08	1.08	.81	.58	.63	1.10	.69	1.09	.98	1.20	1.76
1891,	1.93	1.36	1.21	1.42	.79	.53	.74	.61	.73	1.11	1.56	1.22	2.05
1892,	1.38	1.65	1.16	1.02	.96	.84	.97	.55	.96	.98	1.00	1.01	1.65
1893,	1.53	1.83	1.27	1.25	1.16	.67	.68	.93	.81	1.37	1.16	1.53	1.92
1894,	1.89	1.65	1.04	.86	.93	.75	.57	.44	1.11	1.19	1.22	1.23	2.01
1895,	1.46	1.88	1.24	1.40	.84	.66	.51	.53	.68	1.09	1.47	1.78	2.27
1896,	.97	1.77	1.52	.96	.75	.83	.79	.59	.85	1.10	1.23	1.57	2.22
1897,	1.57	1.15	1.74	1.10	.76	.55	.72	.61	.73	1.12	1.48	1.42	1.76
1898,	1.43	1.63	1.17	.86	.76	.95	.81	.60	.82	1.19	1.25	1.39	1.75
Mean,	1.53	1.58	1.30	1.11	.85	.73	.71	.66	.84	1.12	1.27	1.41	1.92

Maximum Barometer.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum.
1889, ...	30.82	30.97	30.66	30.54	30.40	30.54	30.35	30.45	30.40	30.52	30.67	30.96	30.97
1890, ...	30.94	30.72	30.56	30.57	30.32	30.28	30.27	30.28	30.42	30.41	30.35	30.61	30.94
1891, ...	30.62	30.69	30.57	30.56	30.44	30.22	30.37	30.27	30.45	30.67	30.74	30.55	30.74
1892, ...	30.67	30.72	30.45	30.53	30.43	30.39	30.50	30.24	30.42	30.43	30.44	30.53	30.72
1893, ...	30.61	30.83	30.63	30.65	30.32	30.36	30.25	30.30	30.45	30.65	30.70	30.92	30.92
1894, ...	30.77	30.89	30.57	30.52	30.50	30.33	30.31	30.24	30.63	30.42	30.73	30.53	30.89
1895, ...	30.61	30.44	30.52	30.70	30.55	30.51	30.33	30.29	30.41	30.67	30.73	30.83	30.83
1896, ...	30.56	30.49	30.62	30.60	30.48	30.42	30.49	30.39	30.40	30.62	30.86	30.94	30.94
1897, ...	30.77	30.70	30.88	30.61	30.36	30.28	30.33	30.18	30.40	30.67	30.60	30.60	30.88
1898, ...	30.61	30.64	30.76	30.34	30.33	30.35	30.44	30.26	30.41	30.46	30.53	30.52	30.76
Mean maximum, .	30.70	30.71	30.62	30.56	30.41	30.37	30.36	30.29	30.44	30.55	30.63	30.70	30.86

Minimum Barometer.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Minimum.
1889,	29.20	29.46	29.08	29.38	29.65	29.57	29.67	29.79	29.42	29.56	29.36	29.21	29.20
1890,	29.44	29.37	29.48	29.49	29.51	29.70	29.64	29.18	29.73	29.32	29.37	29.41	29.18
1891,	28.69	29.33	29.36	29.14	29.65	29.69	29.63	29.66	29.72	29.56	29.18	29.33	28.69
1892,	29.29	29.07	29.29	29.51	29.47	29.55	29.53	29.69	29.46	29.45	29.44	29.52	29.07
1893,	29.08	29.00	29.36	29.40	29.16	29.69	29.57	29.37	29.64	29.28	29.54	29.39	29.00
1894,	28.88	29.24	29.53	29.66	29.57	29.58	29.74	29.80	29.52	29.23	29.51	29.30	28.88
1895,	29.17	28.56	29.28	29.30	29.71	29.85	29.82	29.76	29.73	29.58	29.26	29.05	28.56
1896,	29.59	28.72	29.10	29.64	29.73	29.59	29.70	29.80	29.55	29.52	29.63	29.37	28.72
1897,	29.20	29.55	29.14	29.51	29.60	29.63	29.61	29.57	29.67	29.55	29.12	29.18	29.12
1898,	29.18	29.01	29.59	29.48	29.57	29.40	29.63	29.66	29.59	29.27	29.28	29.13	29.01
Mean minimum,	29.17	29.13	29.32	29.45	29.56	29.62	29.65	29.63	29.60	29.43	29.37	29.19	28.94

Mean Temperature (in Degrees F.).

[Completed from daily maximum and minimum readings.]

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Mean.
1889,*	–	–	–	–	–	–	–	–	–	–	–	–	–
1890, ...	29.2	32.0	31.0	45.8	56.3	65.3	68.4	67.2	60.4	48.2	37.2	21.8	46.9
1891, ...	26.4	27.6	32.7	47.5	55.6	65.2	66.3	69.0	64.9	48.7	38.1	36.9	48.2
1892, ...	23.6	26.1	31.4	45.2	56.0	69.3	69.3	68.9	59.3	48.6	37.8	26.3	46.8
1893, ...	16.1	22.9	30.4	43.0	55.8	66.9	68.1	69.2	55.8	52.6	38.2	25.5	45.4
1894, ...	26.4	21.6	39.6	46.7	57.3	67.8	72.9	68.0	65.5	51.5	34.8	26.9	47.9
1895, ...	23.2	19.5	31.2	45.6	59.7	69.1	67.6	69.7	64.1	45.6	40.7	30.5	47.2
1896, ...	20.7	25.0	29.2	48.3	61.1	65.0	71.3	68.8	59.5	47.0	42.2	25.6	47.0
1897, ...	24.7	25.4	33.1	47.1	56.8	62.0	71.6	66.8	60.1	49.8	36.2	28.3	46.8
1898, ...	21.8	26.1	39.7	42.4	55.3	66.1	70.9	70.2	63.6	51.1	37.5	25.9	47.5
Mean, ...	23.6	25.1	33.1	45.7	57.1	66.3	69.6	68.6	60.9	49.2	38.1	27.5	47.1

* Records incomplete.

Range of Temperature (in Degrees F.).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Range.
1889,*	–	–	–	–	–	–	–	–	–	–	–	–	–
1890, ...	57.0	54.5	69.0	57.5	48.5	47.5	54.0	47.0	52.0	52.0	51.0	48.5	100.5
1891, ...	52.5	60.0	57.5	61.5	62.0	60.0	48.5	47.5	55.5	69.0	60.5	51.5	100.0
1892, ...	66.5	53.5	54.5	58.5	56.0	54.0	52.0	44.0	49.0	54.5	53.0	47.0	104.5
1893, ...	63.0	54.5	48.0	48.5	57.0	52.5	49.5	57.0	51.0	57.0	52.0	64.0	109.0
1894, ...	52.0	66.0	56.0	63.0	56.0	55.5	50.0	54.0	56.0	43.0	55.0	55.0	115.0
1895, ...	50.0	55.0	44.0	56.0	62.5	51.0	54.0	52.0	64.0	51.0	57.0	68.0	105.0
1896, ...	53.0	67.0	52.0	67.5	62.5	51.0	41.0	55.0	57.5	49.0	54.0	62.0	111.0
1897, ...	51.0	59.0	60.5	60.0	48.0	47.5	36.0	43.0	59.5	63.5	58.0	62.5	102.5
1898, ...	65.5	73.0	45.5	54.0	46.0	50.0	56.5	46.5	58.5	59.5	56.0	60.0	115.5
Mean, ...	56.7	60.3	54.1	58.4	55.4	52.2	48.0	49.6	55.9	55.4	55.2	57.7	107.0

* Records incomplete.

Maximum Temperatures (in Degrees F.).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum
1889 *	–	–	–	–	–	–	–	–	–	–	–	–	–
1890, ...	61.5	57.5	62.5	79.5	80.0	88.0	94.0	88.5	80.5	78.0	62.5	43.5	94.0
1891, ...	52.0	54.0	56.5	79.5	87.0	94.0	90.0	92.5	91.5	89.0	64.0	60.5	94.0
1892, ...	57.0	46.5	60.5	78.5	84.0	95.0	94.0	94.0	80.0	77.5	67.0	46.0	95.0
1893, ...	50.0	50.0	52.0	67.5	87.0	94.0	90.5	96.0	81.0	80.0	63.0	52.0	96.0
1894, ...	53.0	49.0	73.0	79.0	85.0	93.0	98.0	91.0	91.0	75.0	65.0	51.0	98.0
1895, ...	45.5	45.0	49.0	81.0	92.0	95.0	90.0	90.0	97.0	71.0	72.0	65.0	97.0
1896, ...	41.0	53.0	57.0	88.5	94.5	90.0	91.0	97.0	88.5	72.0	69.0	52.5	97.0
1897, ...	51.0	48.0	59.0	80.5	79.5	85.5	91.0	85.0	91.5	84.0	63.0	59.0	91.5
1898, ...	50.0	54.0	60.0	71.0	78.5	89.5	96.5	91.0	93.0	86.5	62.0	48.0	96.5
Mean maximum, . .	51.2	50.8	58.8	78.3	85.3	91.6	92.8	91.7	88.2	79.2	65.3	53.1	95.4

* Records incomplete.

Minimum Temperatures (in Degrees F.).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Minimum.
1889,*	-	-	-	-	-	-	-	-	-	-	-	-	-
1890, ...	4.5	3.0	—6.5	22.0	31.5	40.5	40.0	41.5	28.5	26.0	11.5	—5.0	—6.5
1891, ...	—0.5	—6.0	—1.0	18.0	25.0	34.0	41.5	45.0	36.0	20.0	3.5	9.0	—6.0
1892, ...	—9.5	—7.0	6.0	20.5	28.0	41.0	42.0	50.0	31.0	23.0	14.0	—1.0	—9.5
1893, ...	—13.0	—4.5	4.0	19.0	30.0	41.5	41.0	39.0	30.0	23.0	11.0	—12.0	—13.0
1894, ...	1.0	—17.0	17.0	16.0	29.0	37.5	48.0	37.0	35.0	32.0	10.0	—4.0	—17.0
1895, ...	—4.5	—10.0	5.0	25.0	29.5	44.0	46.0	38.0	33.0	20.0	15.0	—3.0	—10.0
1896, ...	—12.0	—14.0	5.0	21.0	32.0	39.0	50.0	42.0	31.0	23.0	15.0	—9.5	—14.0
1897, ...	0.0	—11.0	—1.5	20.5	31.5	38.0	55.0	42.0	32.0	20.5	5.0	—3.5	—11.0
1898, ...	—15.5	—19.0	14.5	17.0	32.5	39.5	40.0	44.5	34.5	27.0	6.0	—12.0	—19.0
Mean minimum, . .	—5.5	—9.5	4.7	19.9	29.9	39.4	44.8	42.1	32.3	23.8	10.1	—4.6	—11.8

* Records incomplete.

Mean Dew Point (in Degrees F.).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, ...	26.3	21.2	30.4	43.8	52.8	61.1	62.7	59.5	56.9	39.4	38.3	30.9	43.6
1890, ...	23.8	25.2	26.5	35.6	58.0	57.9	61.5	57.2	55.8	41.0	29.7	14.7	40.6
1891, ...	20.7	21.7	22.6	36.3	44.6	57.0	58.5	62.4	58.1	40.6	30.4	28.2	40.1
1892, ...	18.8	20.9	21.5	33.0	44.9	62.3	60.9	62.1	51.9	41.0	32.1	20.5	39.2
1893, ...	13.9	17.3	24.0	31.4	45.7	58.3	58.8	59.9	49.1	44.2	29.9	21.9	37.9
1894, ...	21.6	17.9	31.1	34.2	52.6	57.9	62.4	58.6	56.2	44.6	27.3	22.3	40.5
1895, ...	19.2	17.1	26.2	35.8	48.7	59.6	59.3	60.4	54.8	35.4	34.4	23.6	39.5
1896, ...	14.3	22.0	25.6	35.9	48.3	53.9	62.4	61.7	54.5	42.4	37.7	19.6	39.9
1897, ...	18.0	18.1	26.9	35.7	48.0	53.3	64.6	59.7	52.7	39.0	31.8	24.2	39.6
1898, ...	18.4	21.8	30.5	34.2	48.8	59.3	64.6	64.6	56.9	46.6	32.7	20.8	41.6
Mean, ...	19.5	20.3	26.5	35.6	49.2	58.1	61.6	60.6	54.7	41.4	32.4	22.7	40.2

Mean Relative Humidity.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889,	79.0	90.0	75.0	78.3	73.8	79.1	78.2	80.4	83.3	75.7	75.4	75.2	78.6
1890,	68.2	74.8	77.3	64.7	67.1	71.3	70.1	74.9	80.9	68.2	67.8	67.2	71.1
1891,	72.2	69.4	63.7	60.1	59.3	65.3	66.1	70.3	72.1	65.5	68.7	68.7	66.8
1892,	73.7	72.8	64.1	54.5	60.3	68.9	65.6	74.9	70.7	65.5	71.0	70.3	67.7
1893,	80.2	74.7	71.4	64.8	66.0	71.1	64.8	70.7	72.8	67.0	68.8	80.9	71.1
1894,	78.8	77.5	67.5	60.5	65.8	68.1	68.2	69.9	74.4	82.7	70.8	79.0	71.9
1895,	82.5	83.9	80.6	68.1	65.0	68.5	72.7	72.7	73.7	69.2	80.5	75.4	74.4
1896,	73.3	87.5	85.3	62.0	62.5	67.3	73.1	79.9	84.0	85.1	82.3	79.8	76.9
1897,	77.1	75.7	78.9	68.2	71.5	73.3	80.1	79.6	76.6	68.7	83.2	83.9	76.4
1898,	85.2	83.1	72.6	72.1	78.4	77.1	79.3	82.1	80.0	83.6	83.4	80.2	79.8
Mean,	77.0	78.9	73.6	65.3	67.0	71.0	71.8	75.5	76.6	73.2	75.2	76.1	73.5

Mean Per Cent. of Cloudiness, from Tri-daily Observations.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889,	55	40	63	55	42	53	54	43	65	60	68	61	55
1890,	52	66	66	50	59	50	56	57	59	64	47	53	57
1891,	61	59	55	49	54	47	54	58	50	54	50	51	53
1892,	63	55	45	42	66	50	35	53	29	46	58	45	49
1893,	52	57	46	55	55	58	44	45	46	40	49	54	50
1894,	53	53	55	53	52	54	50	44	53	44	50	44	50
1895,	51	39	55	54	46	48	58	44	42	42	61	45	49
1896,	43	63	54	39	40	47	50	40	52	63	59	42	49
1897,	46	51	56	46	47	47	64	42	39	39	71	68	51
1898,	66	64	53	68	65	57	53	60	48	62	60	66	60
Mean,	54.2	54.7	54.8	51.1	52.6	51.1	51.8	48.6	48.3	51.4	57.3	52.9	52.4

Hours of Bright Sunshine by Sun Thermometer.

YEAR.	January	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Possible hours, . . .	294	296	371	402	453	457	462	429	373	341	293	283	4,454
1889, ...	134	183	138	191	270	277	182	194	120	129	84	108	2,010
1890, ...	112	131	160	245	225	264	289	199	166	129	143	131	2,194
1891, ...	126	124	195	240	226	248	222	204	224	150	141	143	2,245
1892, ...	128	138	196	244	183	218	287	201	234	178	101	144	2,261
1893, ...	130	111	172	166	188	209	259	225	185	182	133	112	2,072
1894, ...	120	121	150	174	208	180	237	237	176	160	128	159	2,051
1895, ...	153	187	172	188	243	246	192	251	254	197	111	169	2,363
1896, ...	157	168	210	258	297	263	260	254	189	115	105	172	2,448
1897, ...	144	154	188	239	236	248	214	274	221	209	90	108	2,325
1898, ...	132	138	200	168	200	270	236	201	218	157	105	113	2,159
Mean, ...	134	145	178	211	228	242	238	224	199	161	114	136	2,212
Mean per cent., . .	45.7	49.0	48.0	52.5	50.3	53.0	51.5	52.2	53.4	47.2	39.0	48.1	49.7

Precipitation (in Inches).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, ...	3.50*	1.46*	1.02*	3.22*	4.18*	5.40*	10.52	2.72	3.17	4.58	6.04	3.57	49.38
1890, ...	2.61	4.20	5.37	1.73	5.39	1.53	5.63	4.88	5.85	7.13	1.32	2.86	48.50
1891, ...	6.75	4.23	2.99	2.66	1.97	4.75	5.28	4.18	2.66	2.94	2.99	5.40	46.80
1892, ...	5.85	1.90	2.40	0.76	6.28	3.46	4.41	6.47	2.16	0.66	4.98	1.01	40.34
1893, ...	3.33	5.75	3.66	4.41	5.02	3.32	2.59	3.49	2.82	4.88	2.81	4.86	46.94
1894, ...	2.16	1.74	1.77	1.83	4.00	3.13	1.55	0.31	4.63	4.85	3.14	3.53	32.64
1895, ...	3.87	1.05	2.71	5.56	2.07	2.76	3.87	3.46	5.04	4.77	5.36	3.94	44.46
1896, ...	1.07	4.67	6.11	1.32	2.58	2.57	4.96	3.84	5.41	3.23	3.03	0.87	39.66
1897, ...	3.00	2.52	3.53	2.42	4.38	6.65	14.51	4.29	1.94	0.73	5.85	7.23	57.05
1898, ...	7.15	3.80	1.63	3.73	5.61	3.69	4.09	6.85	3.65	6.27	5.48	2.30	54.25
Mean. . .	3.93	3.13	3.12	2.76	4.15	3.73	5.74	4.05	3.73	4.00	4.10	3.56	46.00

* Kindly furnished by Miss S. C. Snell.

Departures from Monthly Normals.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889,	—.43	—1.67	—2.10	.46	.03	1.67	4.78	—1.33	—.56	.58	1.94	.01	3.38
1890,	—1.32	1.07	2.25	—1.03	1.24	—2.20	—.11	.83	2.12	3.13	—2.78	—.70	2.50
1891,	2.82	1.10	—.13	—.10	—2.18	1.02	—.46	.13	—1.07	—1.06	—1.11	1.84	.80
1892,	1.92	—1.23	—.72	—2.00	2.13	—.27	—1.33	2.42	—1.57	—3.34	.88	—2.55	—5.66
1893,	—.60	2.62	.54	1.65	.87	—.41	—3.15	—.56	—.91	.88	—1.29	1.30	.94
1894,	—1.77	—1.39	—1.35	—.93	—.15	—.60	—4.19	—3.74	.90	.85	—.96	—.03	—13.36
1895,	—.06	—2.08	—.41	2.80	—2.08	—.97	—1.87	—.59	1.31	.77	1.26	.38	—1.54
1896,	—2.86	1.54	2.99	—1.44	—1.57	—1.16	—.78	—.21	1.68	—.77	—1.07	—2.69	—6.34
1897,	—.93	—.61	.41	—.34	.23	2.92	8.77	.24	—1.79	—3.27	1.75	3.67	11.05
1898,	3.22	.67	—1.49	.97	1.46	—.04	—1.65	2.05	—.08	2.27	1.38	—1.26	8.25

Wind Movement (in Miles).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1889, ...	5,101	4,828	7,068	5,648	4,056	4,056	4,032	2,811	4,310	4,762	2,589	4,445	53,706
1890, ...	4,914	4,616	5,395	5,020	5,284	3,776	3,976	4,116	3,507	4,143	4,228	5,673	54,648
1891, ...	4,954	4,759	6,261	5,484	4,610	3,713	3,907	3,324	3,201	4,319	5,215	5,465	55,212
1892, ...	5,059	3,438	7,046	5,370	5,056	4,500	3,365	3,390	3,672	4,071	5,231	4,522	54,720
1893, ...	4,056	5,242	5,757	5,384	4,833	3,572	3,640	4,126	3,508	4,198	4,179	3,916	52,411
1894, ...	4,193	4,865	4,406	4,105	2,180	1,838	1,109	1,920	1,414	2,540	4,179	3,508	36,257
1895, ...	2,896	3,920	4,360	4,098	4,071	3,050	2,934	3,397	3,444	5,029	4,156	5,506	46,861
1896, ...	4,943	6,445	8,182	4,674	4,838	3,926	4,048	2,968	4,686	4,544	4,654	5,290	59,198
1897, ...	5,501	4,493	5,363	5,523	5,603	4,208	4,007	3,452	3,506	3,938	4,558	4,068	54,220
1898, ...	3,494	3,699	3,864	5,477	4,769	4,162	3,377	3,111	2,787	3,999	4,856	4,830	48,425
Mean, ...	4,511	4,630	5,770	5,078	4,530	3,680	3,439	3,262	3,404	4,154	4,385	4,722	51,566

Maximum Wind Pressure (in Pounds per Square Foot).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum.
1889, . . .	26.00	24.0	16.75	15.50	9.00	11.50	10.00	6.5	9.75	12.25	14.50	29.0	29.00
1890, . . .	27.75	17.5	13.50	11.50	16.50	10.00	9.25	13.0	5.00	11.00	9.50	24.5	27.75
1891, . . .	16.25	13.5	10.50	14.00	10.75	10.50	4.50	2.5	4.00	9.50	15.75	14.0	16.25
1892, . . .	10.50	11.5	20.50	16.75	15.75	20.50	11.50	7.5	15.50	12.50	16.00	13.5	20.50
1893, . . .	12.00	20.0	18.50	24.50	24.75	9.00	13.00	37.5	14.50	23.00	14.00	18.5	37.50
1894, . . .	20.00	22.5	11.50	15.50	14.50	14.00	9.50	9.5	13.00	10.00	18.00	15.0	22.50
1895, . . .	13.00	25.0	20.00	10.00	7.00	8.00	8.00	5.5	43.00	14.00	22.00	24.0	43.00
1896, . . .	15.00	24.5	19.00	18.00	25.00	7.75	8.50	12.5	19.00	12.00	15.00	12.0	25.00
1897, . . .	18.50	10.0	13.50	14.00	22.00	7.00	12.00	14.0	20.00	11.50	20.00	12.0	22.00
1898, . . .	22.50	15.5	15.50	10.00	18.00	8.50	17.50	13.0	30.50	12.00	19.00	28.0	30.50
Maximum, . .	27.75	25.0	20.50	24.50	25.00	20.50	17.50	37.5	43.00	23.00	22.00	29.0	43.00

Maximum Velocity of Wind (in Miles per Hour).

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Maximum.
1889, ...	72	69	58	56	42	48	45	36	44	50	54	76	76
1890, ...	74	59	52	48	57	45	43	51	32	47	44	70	74
1891, ...	57	52	46	53	46	46	30	23	28	44	56	53	57
1892, ...	46	48	64	58	56	64	48	39	56	50	57	52	64
1893, ...	49	63	61	70	70	42	51	87	54	68	53	61	87
1894, ...	63	67	48	56	54	53	44	44	51	45	60	55	67
1895, ...	51	71	63	45	37	40	40	33	93	53	66	69	93
1896, ...	55	70	62	60	71	39	41	50	62	49	55	49	71
1897, ...	61	45	52	53	66	37	49	53	63	48	63	49	66
1898, ...	67	56	56	45	60	41	59	51	78	49	62	75	78

Snow, Frost and Weather.

YEAR.	Last Snow.	First Snow.	Total Snowfall (Inches).	Last Frost.	First Frost.	Number of Days .01 Precipitation.	Number of Clear Days.	Number of Fair Days.	Number of Cloudy Days.
1889,	April 2,	Oct. 13,	26.0	May 26,	Sept. 21,	119	94	110	161
1890,	April 8,	Oct. 19,	43.5	May 12,	Sept. 25,	141	137	105	123
1891,	May 5,	Nov. 26,	54.2	May 19,	Oct. 12,	112	145	103	117
1892,	April 10,	Nov. 5,	42.5	May 10,	Sept. 30,	108	123	109	134
1893,	April 21,	Nov. 4,	74.3	May 8,	Sept. 3,	143	101	96	168
1894,	April 12,	Nov. 5,	71.5	May 22,	Aug. 22,	125	107	83	175
1895,	April 3,	Oct. 20,	61.0	May 17,	Aug. 22,	119	118	110	137
1896,	April 7,	Nov. 14,	44.0	May 1,	Sept. 24,	108	132	102	132
1897,	April 27,	Nov. 12,	52.8	May 8,	Sept. 22,	127	108	109	148
1898,	April 6,	Nov. 24,	69.5	April 27,	Sept. 21,	135	78	138	149

Summary for the Ten Years 1889–98.

Barometer (Pressure in Inches).

Maximum, reduced to freezing, Feb. 26, 1889, 11 A.M.,	30.650
Minimum, reduced to freezing, Feb. 8, 1895, 7 A.M.,	28.240
Maximum, reduced to freezing and sea level, Feb. 26, 1889, 11 A.M.,	30.970
Minimum, reduced to freezing and sea level, Feb. 8, 1895, 7 A.M.,	28.560
Mean,	30.029
Total range,	2.410
Greatest annual range, 1895,	2.270
Least annual range, 1892,	1.650
Mean annual range,	1.920
Greatest monthly range, January, 1891,	1.930
Least monthly range, July, 1895,	.510
Mean monthly range,	1.090

Air Temperature (in Degrees F.).

Highest, July 20, 1894, 5 P.M.,	98.000
Lowest, Feb. 3, 1898, 6 A.M.,	—19.000
Mean,	47.100
Total range,	117.000
Greatest annual range, 1898,	115.500
Least annual range, 1891,	100.000
Mean annual range,	107.000
Greatest monthly range, February, 1898,	73.000
Least monthly range, July, 1897,	36.000
Mean monthly range,	54.900
Greatest daily range, Feb. 18, 1892,	52.500
Least daily range, April 5, 1898,	2.500
Mean daily range,	22.100

Humidity.

Mean dew point,	40.200
Mean force of vapor,	.430
Mean relative humidity,	73.500

Precipitation (in Inches).

Total rain or melted snow,	460.000
Total snowfall,	539.300
Greatest annual precipitation, 1897,	57.050
Least annual precipitation, 1894,	32.640
Mean annual precipitation,	46.000
Greatest monthly precipitation, July, 1897,	14.510
Least monthly precipitation, October, 1892,	.660
Mean monthly precipitation,	3.830

Greatest in twenty-four hours, July 12-13, 1897,	5.650
Greatest in one hour, July 30, 1898,	1.500
Unusual rains: 1889, June 15, 2.10 inches in four hours; 1896, July 7, 1.10 inches in thirty minutes; 1897, June 9, 4.08 inches in twenty hours; July 13-14, 8 inches in forty-four hours; 1898, July 30, 2.65 inches in two hours; September 10, .95 inch in twenty minutes. Number of days on which .01 inch or more rain or melted snow fell,	1,241.000

Wind (in Miles).

Total movement,	515,638
Greatest annual movement, 1896,	59,198
Least annual movement, 1894,	36,257
Mean annual movement,	51,566
Greatest monthly movement, March, 1896,	8,182
Least monthly movement, July, 1894,	1,109
Mean monthly movement,	4,297
Greatest daily movement, Nov. 27, 1898,	675
Least daily movement, Sept. 29, 1894, and March 7, 1895,	–
Mean daily movement,	141

Maximum pressure per square foot, 43 pounds, = 93 inches per hour, Sept. 11, 1895, 3 P.M.

Weather.

Mean cloudiness observed,		52.40 per cent.
Total cloudiness by the sun thermometer,	22,400	= 50.30 per cent.
Number hours bright sunshine recorded,	22,120	= 49.70 per cent.
Number of clear days,		1,143
Number of fair days,		1,065
Number of cloudy days,		1,444

Gales of 75 or more miles per hour: 1889, Dec. 26, 76, N.W.; 1893, Aug. 29, 87, S.W.; 1895, Sept. 11, 93, N.E.; 1898, Sept. 7, 78, S.W.; Dec. 4, 75, E.S.E.

REPORT OF THE HORTICULTURIST.

SAMUEL T. MAYNARD.

The lines of experimentation carried on by this division have been kept strictly within the limits of practical horticulture, devoting especial attention to the growth of common fruit and garden crops, and their protection from insect and fungous pests.

New varieties of fruits, vegetables, ornamental trees, shrubs and plants of promise have been obtained and tested under varying conditions, and many new seedlings produced. For the work of testing varieties a large collection of standard varieties from different sections of the country have been obtained, that, when a new variety is to be tested, careful comparison may be made under conditions where the exact value of standard varieties is known. As far as possible, new varieties are grown under many varying conditions, and very careful inquiry is made of their behavior in many localities.

Previous reports have given the number of varieties of the different kinds of fruits, vegetables, flowers, etc., under experiment, to which have been added the following number of new varieties the past season: apples, four; pears, five; plums (domestic), three; plums (Japanese), seven; plums (American), seven; peaches, five; quinces, two; cherries, four; grapes, four, besides numerous seedlings; blackberries, three; red raspberries, two, and a large collection of seedlings; strawberries, twenty, and many seedlings; chestnuts (Japanese, Spanish and native varieties), eight; walnuts (species and varieties), six; several new hardy ornamental trees, shrubs and plants, and many new varieties of ornamental plants for the greenhouse and summer outdoor decoration.

Immediate results are constantly called for in the case of widely advertised new varieties, but such results can be obtained only under a series of seasons and varying conditions of growth. This work of testing varieties is begun at once upon introduction, and is hastened by all possible means.

The experiments under way, in addition to the testing of varieties, are as follows: —

1. The girdling of the grape vine for profit.
2. Spraying fruit trees when in bloom, to change the bearing year.
3. Spraying peach trees during the winter with lime, to protect the flower buds from winter-killing.
4. The use of dilute copper sulfate in place of the ammoniacal carbonate of copper.
5. The testing of insecticides and fungicides.
6. The testing of spraying apparatus.
7. The use of clear kerosene and kerosene and water for the destruction of scale insects and aphides.
8. The protection of young fruit trees from mice.
9. Various kinds of grafting wax.
10. Various methods of grafting.
11. Whole roots and piece roots in apple root-grafting.
12. Different kinds of stocks for the pear.
13. Growing seedling fruit-tree stocks.
14. The use of hydrocyanic acid gas for the destruction of insects under glass.
15. Turf culture *v.* cultivation in growing apples.
16. Amount and kinds of fertilizers needed for best growth of fruits.
17. Green manuring for orchards.
18. Comparative hardiness of varieties of Japanese plums.
19. Growth of lettuce under glass.
20. Growth of tomatoes under glass.

Assistance has been given many horticulturists by visiting their places or answering inquiries by letter, which takes a large share of the time of the head of the division. Assistance has also been given in many places in planning ornamental planting of home and public grounds.

REPORT OF THE ENTOMOLOGIST.

CHARLES H. FERNALD.

Since my last report the entomological work of the station has proceeded along its usual lines. A large amount of correspondence has been carried on, and many letters of inquiry from residents of this State have been answered. Believing, however, that the opportunities afforded by this division of the experiment station were either not known of by many, or that the way in which to make use of them was not understood, the following note on the work was prepared: —

Free Aid for the People.

Prevention of Loss by Injurious Insects.

The attacks of injurious insects probably cause the loss of several millions of dollars in Massachusetts alone each year. This has not always been the case, but insects are becoming more abundant and consequently more destructive. Much of this destruction, however, could be either in part or wholly prevented if the proper methods of treatment were made use of, and that this is not more frequently done is very unfortunate. It is probable that the reason for the apparent negligence in this regard is due to ignorance as to what the insect is in each particular case, and what to do to prevent its ravages. It is this very uncertainty which results in nothing being done in most cases.

In order to provide this information for residents of the State, the entomological division of the Hatch Experiment Station at Amherst offers its services without charge to all who may desire them. To obtain this assistance, write to the entomologist, Hatch Experiment Station at Amherst, Mass., describing the trouble, and also, if possible, send samples of the injury and the insect causing it, and attention will at once be given to the matter.

As the Hatch Experiment Station of Massachusetts is supported in part by State appropriation, such a use of its facilities by the

people of the State is not only justifiable but most desirable, for it was established for just that purpose; and no one who incurs loss by insect ravages can excuse himself for that loss except on the ground of ignorance that such assistance can be obtained.

Over eight hundred of these circulars were sent out to the newspapers, granges and other organizations of the State, with the request that the facts contained therein be given the greatest publicity. As these slips were not circulated till December, 1899, it is not possible to ascertain the results, but a considerable increase in the already large correspondence is anticipated during the coming year.

Last June my assistant, Mr. R. A. Cooley, was appointed professor of zoölogy and entomology at the Montana State College. Mr. Cooley is a careful and thorough investigator, and proved himself a very efficient and valuable assistant to me. The loss of his services rendered necessary the appointment of some one to take his place. As it was advisable for many reasons to obtain a man of large experience, Dr. H. T. Fernald of Pennsylvania, for nine years professor of zoölogy and entomology at the Pennsylvania State College, and for the past two years State entomologist of Pennsylvania, was elected associate entomologist, to take the place made vacant by the resignation of Mr. Cooley.

The San José Scale.

The San José scale is now known to occur in injurious abundance at more than thirty different places in Massachusetts, — in fact, it may be said to be generally distributed over the State. It has probably been introduced from several other States, as there is nothing except the objections of purchasers to prevent its being brought in on every plant purchased. Its presence, however, and the serious destruction it causes, have led a number of States to pass laws excluding all stock from outside their borders unless accompanied by an authorized certificate that the stock had been inspected and no scale found. This action was most inconvenient for Massachusetts nurserymen, who were often thus prevented from filling orders to go to States having such laws. To meet this difficulty, the committee of the trustees

of the college, in charge of the experiment station, authorized the entomological division of the station to inspect nurseries when requested to do so by their owners, and to give authorized certificates where no scale is found, charging for this work only the actual expenses incurred. This action was not a required one, and was taken solely for the purpose of accommodating nurserymen, many of whom have already shown their appreciation of the arrangement and have availed themselves of the opportunity thus afforded them.

Bulletin on Chionaspis.

On the 10th of August, 1899, the work of Mr. R. A. Cooley on the different species of *Chionaspis* and *Hemichionaspis* was published in a special bulletin of the station. This bulletin, treating of many of the important scale insects which have recently attracted so much attention because of the injury they do to fruit and other trees, was fully illustrated, and has received high commendation not only in this country but also in Europe.

The Grass Thrips.

Studies on the grass thrips have been continued during the year by Mr. W. E. Hinds, one of the senior students, with most satisfactory results, and are published as an appendix to the college catalogue. As these studies are largely technical, such of the facts as have an economic bearing will also be published in a bulletin for the use of the farmers of the State.

The Clover-head Beetle.

Work on the clover-head beetle (*Phytonomus nigrirostris*) has been continued during the year by Mr. C. M. Walker, and the results are nearly ready for publication. Its life history has been nearly completed, and the best methods of treatment are being investigated. This work will be published as soon as completed.

Raupenleim.

This substance, which is of such value for banding trees liable to the attacks of the canker worms, tussock moth, etc., has heretofore been manufactured by a secret process in Ger-

many. During the past year the chemist of the Gypsy Moth Commission, Mr. F. J. Smith, made experiments at the chemical laboratory of the insectary, to determine its composition. These experiments proved very successful, and in consequence raupenleim can now be manufactured in this country at a low cost. This one discovery has been estimated as worth half a million of dollars to the farmers and fruit growers of the United States.

The Gypsy Moth.

The work of exterminating the gypsy moth, with which I have been connected since 1891, has been carried on during the past year with marked success, and the insect has been reduced to such an extent over almost the entire territory that one who has kept in close touch with the field work for several years past cannot fail to be impressed by the great gain that has been made towards the extermination of this pest.

There is no longer any question, in the minds of those who have made a careful personal investigation of the work throughout the infested territory, that the gypsy moth can be exterminated. Nearly all of the prominent economic entomologists of this country have inspected the work with great care, and have become fully convinced that extermination is possible, if the Legislature each year promptly grants the full appropriation asked for this purpose by the gypsy moth committee. The entire responsibility now rests with the Legislature.

The Brown-tail Moth.

This insect has now become widely distributed in the eastern part of this State, and even extends into New Hampshire; it is therefore believed to be impossible to exterminate this pest with any appropriations that the two States in which it now occurs would be likely to make. When attention was first called to this insect, in the spring of 1897, the matter was laid before Governor Wolcott, who sent a message to the Legislature recommending an appropriation of $10,000 for the extermination of the pest, which then occurred only in a very limited area. It was believed that this amount

would be sufficient to stamp out the insect. The Legislature, however, refused to make any appropriation for this purpose, and the inevitable results followed.

In consideration of the failure of the Legislature to prevent the spread of the brown-tail moth over the country, the gypsy moth committee have authorized me, with the assistance of those associated with me, to "collect such information, both in this country and Europe, in regard to the brown-tail moth, and make such experiments with the insect as may be useful to the committee in future dealing with the creature and necessary for the proper enlightenment of the public on the subject, with a view to publish the said information, if it may appear desirable."

In accordance with this action of the gypsy moth committee a large amount of time has already been spent on this work, but it is far from being completed, and it is impossible at present to say just when the work will be ready for publication.

Monograph of the Pyralidæ.

I have been engaged for many years in a critical study of the microlepidoptera of North America, and have already published several monographs on certain families of these insects. I am now at work on a monograph of the Pyralidæ, which will probably be ready for publication some time this year.

The Card Catalogue.

The card catalogue of insects now contains over forty thousand cards, and is continually growing in size, as constant additions are made to it from the new journals and other entomological publications as they are received. Only those insects occurring in North America have been catalogued in the past, but the literature of the scale insects (Coccidæ) of all countries is now being added. This is rendered necessary, as these insects are being imported into our country from different parts of the world without restriction in any State except California.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Assistants: E. B. HOLLAND, F. W. MOSSMAN, B. K. JONES, P. H. SMITH, JR.

PART I. — LABORATORY WORK.

Outline of Year's Work.

PART II. — FEEDING EXPERIMENTS AND DAIRY STUDIES.

PART I.

EXTENT OF CHEMICAL WORK.

The work of the chemical laboratory connected with this department has materially increased during the past year, notwithstanding the prolonged illness of Dr. Lindsey, which necessitated a temporary rearrangement of the staff, leaving the bulk of the analytical work to be carried on by two assistants.

There have been sent in for examination 167 samples of water, 144 of milk, 193 of cream, 36 of pure and process butter, 25 of oleomargarine, 147 of feed stuffs and 52 of miscellaneous substances.

In connection with experiments by this and other divisions of the station there have been analyzed 62 samples of milk, 54 of butter and 429 of fodders and feed stuffs.

In addition to the above, 748 samples of commercial concentrated feed stuffs have been collected under the provision

of the feed law, of which 736 samples have been tested, either individually or in composite. This makes a total of 2,045 substances analyzed during the year, as against 1,875 last year and 1,147 in the year previous. There have also been carried on for the Association of Official Agricultural Chemists investigations relative to the best methods for the determination of starch, pentosans and galactan in agricultural products.

Character of Chemical Work.

Water. — Sanitary examinations of water have been carried out, as in previous years, according to the Wanklyn process, to determine its general fitness for domestic purposes and for the use of live stock.

Persons whose water supply is other than that of a city or town system should use every possible means to guard it against pollution arising from sinks, vaults and stables, or from the entrance of surface water and animal and vegetable matter. The latter, while not in itself highly injurious to health, is objectionable, as it favors the rapid propagation of bacteria and other micro-organisms. The detection of specific disease germs in water is, however, not a function of the chemist, but of the bacteriologist.

Frequent cases of poisoning result from conducting drinking water through lead pipe, and such a practice cannot be too severely condemned, for the poison, once assimilated, is very difficult to remove from the system. At least five samples examined during the past year have shown its presence. Soft waters as a rule have a much greater solvent action upon lead than hard waters. Wells and springs ought to be thoroughly cleaned at regular intervals.

It is of great importance that the utmost care be exercised in taking the sample for analysis, otherwise the chemical examination, conducted under the most careful and exacting conditions, is of little or no value. The quantity necessary is two to three quarts, collected in a thoroughly cleaned and well-rinsed glass bottle, stoppered with a new cork, over which is to be tied a clean piece of cotton cloth. An air space of about one inch should be left between cork and liquid, to allow for expansion. In case of pond water, the sample should be taken from below the surface, being care-

ful to avoid the surface scum and the sediment at the bottom. The chemist's report upon the character of the water must necessarily be a matter of judgment, based on the analysis and the information furnished by the party sending the sample. Accurate replies to the following questions are necessary to a complete understanding of each case, and are for the interest of the person sending the water: —

1. Sources, whether from spring, stream, pond, reservoir or well.
2. Character of soil in which located.
3. Distance from any possible source of pollution, and character of the same.
4. Kind of pipe used for conducting the water.

Ship samples at once by express, charges prepaid. In making the report of an analysis a printed form is used, which explains the results so as to be readily understood by any one.

The examination of mineral or spring waters for which medicinal properties are claimed, or those intended for commercial purposes, does not fall within the scope of our duties.

Milk. — The samples sent in show a wide variation both in solids and fat, a considerable number falling below the Massachusetts legal standard,* indicating a need on the part of certain milkmen and others of introducing better stock and disposing of inferior animals.

In taking a sample for analysis, mix the entire milking by pouring three or four times from one vessel to another, and immediately fill a pint bottle. Mark each sample, stating kind of milk (whole, skim or buttermilk) and the tests desired, together with the name and address of the shipper; the package to be marked "*Immediate Delivery*," and sent by express, prepaid. Samples sent from a considerable distance should be treated with four drops of forty per cent. formaldehyde (obtained at any apothecary's), to insure the preservation of the sample.

Cream. — Everything said in regard to the sampling and shipping of milk applies equally well to cream.

* In the months of October, November, December, January, February and March, 13 per cent. solids and 3.7 per cent. fat are required, but during the remainder of the year only 12 per cent. solids and 3 per cent. fat.

Butter. — In connection with the feeding experiments conducted at the barn last season many samples of butter were analyzed, and very thorough examinations of the butter fat, both in regard to its chemical composition and physical properties, were made.

"Renovated" or "process" butter having become of considerable prominence in the market, a law was passed by the last Legislature forbidding its sale except when plainly marked, in one-half inch type, "Renovated butter." Several samples have been identified in this laboratory by means of a microscopical examination, general characteristics of the melted fat and curd, together with the Reichert number; and a much larger number of oleomargarines have been identified by the same methods.

Cattle Feeds. — The feed law passed by the State Legislature, which took effect in July, 1897, is apparently meeting with good success. The work is carried out by this department, the assistants making a semi-annual canvass of the State, taking samples of all the prominent concentrated feed stuffs. The samples so collected are carefully analyzed, and the results published in bulletins from time to time. The purpose of this work is to exclude poor and adulterated feeds, and to maintain products of a uniform grade.

The effect of the law on the quality of cotton seed meal has been very marked. In the earlier collections inferior meals were common, but during the present season but few were found, and the average protein content is many per cent. higher. Low-grade wheat feeds and oat feeds of unknown manufacture still remain in the market, and probably will to some extent until a guarantee is required on all feeds and power given to enforce the same.

PART II.

FEEDING EXPERIMENTS AND DAIRY STUDIES.

An investigation was instituted last season to ascertain the effect produced on the quantity and quality of butter fat by feeding ground flax-seed meal containing thirty-six per cent. of oil, as compared with a normal linseed ration.

Following this, a long series of feeding experiments was begun, the object being to demonstrate, if possible, the effect of each of the food components, protein, fat and carbohydrates, as found in different feed stuffs, — linseed meal, gluten meal, cotton seed meal, etc., — upon the composition and physical characteristics of the resulting butter fat. In each case the experiment was compared with a standard ration supposed to be without special effect on the butter fat. It is evident that such a task involves a large amount of careful and long-continued work, but as soon as positive results are obtained they will be published.

Digestion Experiments.

Digestion experiments were conducted last winter and spring in the same careful manner as in previous years, using two or three sheep in each trial. The grains fed were oat feed, Parson's $6 feed, four lots of "Bourbon" distillers' grains (brands X., XX., XXX. and XXXX.), rye distillers' grains, Cleveland flax meal and Chicago gluten meal.

The digestion coefficients, together with complete data, will be reported at a later date.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.

Assistants: HENRI D. HASKINS, CHARLES I. GOESSMANN, SAMUEL W. WILEY.

Part I. — Report on Official Inspection of Commercial Fertilizers.

Part II. — Report on General Work in the Chemical Laboratory.

Part I. — Report on Official Inspection of Commercial Fertilizers and Agricultural Chemicals during the Season of 1899.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 67; of these, 38 have offices for the general distribution of their goods in Massachusetts, 10 in New York, 5 in Connecticut, 3 in Vermont, 3 in Rhode Island, 3 in Canada, 2 in Pennsylvania, 1 in Maine, 1 in New Jersey and 1 in Illinois.

Two hundred and ninety-one distinct brands of fertilizer, including chemicals, have been licensed in the State during the year.

Three hundred and eighty-four samples of fertilizers have thus far been collected in the general markets by experienced assistants in the station.

Three hundred and sixty-two samples were analyzed at the close of November, 1899, representing 289 distinct brands of fertilizer. These analyses were published in three bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 59, March; No. 62, July; and No. 63, November, 1899.

The samples not already analyzed, together with others that may be collected before the first of May, 1900, will be examined with a view of being published in our spring bulletin.

During the season the inspector has caused samples to be taken in the towns and villages distributed throughout the State, and representing each county within the Commonwealth. Wherever more than one sample of a given brand has been collected in different parts of the State, a composite sample has been made up of equal weights of the several samples, and an analysis made of the homogeneous mixture. It is believed that an analysis of this nature more fairly represents the composition of the fertilizer than the analysis of any one sample.

It has not always been possible to secure a complete list of the samples licensed in the State; but as thorough a canvass as possible is annually made, varying more or less the towns to be visited from year to year, as seems advisable to the inspector. The methods of sampling are those laid down by our State laws for the regulation of the trade in commercial fertilizers.

For the readers' benefit the following abstract of the results of our analyses are here inserted: —

	1898.	1899.
(*a*) Where three essential elements of plant food were guaranteed:—		
Number with three elements equal to or above the highest guarantee,	5	16
Number with two elements above the highest guarantee,	17	27
Number with one element above the highest guarantee,	77	73
Number with three elements between the lowest and highest guarantee,	85	88
Number with two elements between the lowest and highest guarantee,	93	84
Number with one element between the lowest and highest guarantee,	54	58
Number with two elements below the lowest guarantee,	19	19
Number with one element below the lowest guarantee,	90	68
(*b*) Where two essential elements of plant food were guaranteed:—		
Number with two elements above the highest guarantee,	5	7
Number with one element above the highest guarantee,	24	32
Number with two elements between the lowest and highest guarantee,	25	20
Number with one element between the lowest and highest guarantee,	17	27
Number with two elements below the lowest guarantee,	2	2
Number with one element below the lowest guarantee,	8	18
(*c*) Where one essential element of plant food was guaranteed:—		
Number above the highest guarantee,	18	10
Number between lowest and highest guarantee,	23	16
Number below lowest guarantee,	15	10

A comparison of the above-stated results of our inspection with the results of 1898 shows, on the whole, a marked superiority in favor of the samples analyzed in 1899.

Wherever a discrepancy has arisen between the results of our analyses and the manufacturer's guarantee, it has been evident that imperfect mixing has been the cause, and not a desire of the manufacturer to place inferior goods on the market. It should be remembered, when purchasing fertilizers, that the responsibility of the manufacturer or dealer ends with furnishing an article corresponding in its composition with the lowest stated guarantee of each of the three essential elements of plant food.

From a careful scrutiny of the results of analyses published in the three bulletins during the year it becomes an easy matter for the farmer to intelligently select his fertilizers for the next year's consumption, always bearing in mind that the fertilizer costing the least per ton is not always the most

economical fertilizer to buy, but rather the one that will furnish the greatest amount of nitrogen, potassium oxide and phosphoric acid, in a suitable and available form, for the same money.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1898 and 1899 (Cents per Pound).

	1898.	1899.
Nitrogen in ammonia salts,	14.00	15.00
Nitrogen in nitrates,	13.00	12.50
Organic nitrogen in dry and fine ground fish, meat, blood and in high-grade fertilizers.	14.00	14.00
Organic nitrogen in fine bone and tankage,	13.50	14.00
Organic nitrogen in medium bone and tankage,	10.00	10.00
Phosphoric acid soluble in water,	4.50	4.50
Phosphoric acid soluble in ammonium citrate,	4.00	4.00
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pomace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.50	2.00
Phosphoric acid insoluble (in water and in ammonium citrate) in mixed fertilizers.	2.00	2.00
Potash as sulfate (free from chlorides),	5.00	5.00
Potash as muriate,	4.25	4.25

The cost of some of the leading forms of nitrogen shows an increase, as compared with the preceding year, 1898.

The above trade values are based on the market cost, during the six months preceding March, 1899, of standard raw materials which are largely used in the manufacture of compound fertilizers found in our markets. The following is a list of such materials: —

Sulfate of ammonia.	Nitrate of soda.
Azotine.	Dried blood.
Cotton-seed meal.	Castor pomace.
Linseed meal.	Dry ground fish.
Bone and tankage.	Dry ground meat.
Dissolved bones.	Ground phosphate rock.
Acid phosphate.	Refuse bone-black.
High-grade sulfate of potash.	Muriate of potash.
Sulfate of potash and magnesia.	Kainite.
Sylvinite.	Crude saltpetre.

How to use the table of trade values in calculating the approximate value of a fertilizer: Calculate the value of each of the three essential articles of plant food (nitrogen, phosphoric acid and potassium oxide, including the different forms of each wherever different forms are recognized in the table) in one hundred pounds of the fertilizer, and multiply each product by twenty, to raise it to a ton basis. The sum of these values will give the total value of the fertilizer per ton at the principal places of distribution. An example will suffice to show how this calculation is made: —

Analysis of Fertilizer (Pounds in One Hundred Pounds of Fertilizer).

Nitrogen,	4
Soluble phosphoric acid,	8
Reverted phosphoric acid,	4
Insoluble phosphoric acid,	2
Potassium oxide (as sulfate),	10

	Value per One Hundred Pounds.	Value per Two Thousand Pounds.
Four pounds nitrogen, at 14 cents,	$0.56×20	=$11.20
Eight pounds soluble phosphoric acid, at 4½ cents,	.36×20	= 7.20
Four pounds reverted phosphoric acid, at 4 cents,	.16×20	= 3.20
Two pounds insoluble phosphoric acid, at 2 cents,	.04×20	= .80
Ten pounds potassium oxide, at 5 cents,	.50×20	= 10.00
Value per ton,		$32.40

The following table gives the average analysis of officially collected fertilizers for 1899: —

NATURE OF MATERIAL.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizers,	11.86	2.96	2.82	4.65	3.29	3.19	11.13	8.77	7.94	6.67	5.16	4.92
Ground bones,	5.23	2.99	2.63	-	5.58	18.61	24.19	22.53	5.58	6.67	-	-
Tankage,	5.75	4.88	4.41	-	4.99	14.49	18.66	16.33	5.83	-	-	-
Dissolved bone-black,	14.02	-	-	13.62	2.82	-	16.76	16.00	16.44	15.00	-	-
Wood ashes,	9.50	-	-	-	-	-	1.57	1.00	-	-	6.37	4.50
Cotton-hull ashes,	10.44	-	-	-	6.88	1.28	8.16	8.00	6.88	-	27.74	25.00
Cotton-seed meal,	7.79	7.09	6.96	-	-	-	-	-	-	-	-	-
Nitrate of soda,	1.65	15.71	15.36	-	-	-	-	-	-	-	-	-
Sulfate of ammonia,	1.94	21.00	20.60	-	-	-	-	-	-	-	-	-
High-grade sulfate of potash,	1.17	-	-	-	-	-	-	-	-	-	48.42	48.95
Sulfate of potash and magnesia,	3.93	-	-	-	-	-	-	-	-	-	26.70	25.28
Muriate of potash,	1.43	-	-	-	-	-	-	-	-	-	49.68	50.27

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State of Massachusetts during the Past Year (May 1, 1899, to May 1, 1900), and the Brands licensed by Each.

The Armour Fertilizer Works, Chicago, Ill.: —
- Bone Meal.
- Bone and Blood.
- Ammoniated Bone and Potash.
- All Soluble.
- Bone, Blood and Potash.
- Grain Grower.
- Fruit and Root Crop Special.

Wm. H. Abbott, Holyoke, Mass.: —
- Eagle Brand for Grass and Grain.
- Complete Tobacco Fertilizer.
- Animal Fertilizer.

American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.
- Cotton-hull Ashes.

The American Jadoo Co., Philadelphia, Pa.: —
- Jadoo Liquid.

Butchers' Rendering Co., Fall River, Mass.: —
- Bone and Tankage.

Bartlett & Holmes, Springfield, Mass.: —
- Pure Ground Bone.
- Animal Fertilizer.
- Tankage.

The East India Chemical Works (H. J. Baker & Bro., proprietors), New York, N. Y.: —
- Standard Un X Ld Fertilizer.
- Special Complete Strawberry Manure.
- Special Complete Potato Manure.
- Special Complete Cabbage Manure.
- Special Complete Grass and Lawn.
- Complete Manure for General Use.
- Pure Ground Raw Bone.
- Castor Pomace.

C. A. Bartlett, Worcester, Mass.: —
- Fine-ground Bone.
- Animal Fertilizer.

Berkshire Mills Co., Bridgeport, Conn.: —
- Complete Fertilizer.
- Ammoniated Bone Phosphate.

Hiram Blanchard, Eastport, Me.: —
- Fish, Bone and Potash, H B.
- Fish Scrap No. 2, H B.

Bowker Fertilizer Co., Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate.
- Bowker's Lawn and Garden Dressing.
- Bowker's Special Fertilizers.
- Bowker's Potatoes and Vegetables.
- Bowker's Fish and Potash, Square Brand.
- Bowker's Potato Phosphate.
- Bowker's Market-garden Manure.
- Bowker's Sure Crop Phosphate.
- Bowker's High-grade Fertilizer.
- Bowker's Bone and Wood Ash Fertilizer.
- Bowker's Essex County Fertilizer.
- Bowker's Ground Bone.
- Gloucester Fish and Potash.
- Nitrate of Soda.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulfate of Potash.
- Dried Blood.
- Wood Ashes.

William E. Brightman, Tiverton, R. I.: —
- Brightman's Potato and Root Manure.
- Brightman's Phosphate.
- Brightman's Fish and Potash.

Bradley Fertilizer Co., Boston, Mass.: —
- Bradley's Dry Ground Fish.
- Bradley's Strawberry Manure.
- Bradley's English Lawn Fertilizer.
- Bradley's New Method Fertilizer.
- Bradley's Eclipse Phosphate.
- Bradley's Niagara Phosphate.
- Bradley's Columbian Fish and Potash.

Bradley Fertilizer Co. — *Con.*
- Bradley's Circle Brand Extra Fine-ground Bone with Potash.
- Bradley's X. L. Phosphate.
- Bradley's Potato Manure.
- Bradley's Potato Fertilizer.
- Bradley's Complete Manures.
- Bradley's Fish and Potash.
- Bradley's Corn Phosphate.
- Bradley's Fine-ground Bone.
- Ammoniated Bone Phosphate.
- Breck's Lawn and Garden Dressing.
- Dissolved Bone-black.
- Sulfate of Potash.
- Muriate of Potash.
- Nitrate of Soda.
- Kainite.

Joseph Breck & Sons., Boston, Mass.: —
- Breck's Market-garden Manure.

Daniel T. Church, Providence, R. I. (E. Wilcox, general agent): —
- Church's B. Special Fertilizer.
- Church's C. Standard Fertilizer.
- Church's D. Fish and Potash.

Clark's Cove Fertilizer Co., Boston, Mass.: —
- Clark's Cove Bay State Fertilizer, G. G.
- Clark's Cove King Philip Guano.
- Clark's Cove White Oak Pure Ground Bone.
- Clark's Cove Bay State Potato Manure.
- Clark's Cove Great Planet Manure.
- Clark's Cove Bay State Fertilizer.
- Fish and Potash.
- Potato Fertilizer
- High-grade Sulfate of Potash.
- Muriate of Potash.
- Nitrate of Soda.

Cleveland Dryer Co., Boston, Mass.: —
- Cleveland Fertilizer
- Cleveland Potato Phosphate.
- Cleveland Superphosphate.
- Cleveland Grass Fertilizer.
- Cleveland Corn and Grain Phosphate.

E. Frank Coe Co., New York, N. Y.: —
- E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
- E. Frank Coe's High-grade Potato Fertilizer.

E. Frank Coe Co. — *Con.*
- E. Frank Coe's Bay State Phosphate.
- E. Frank Coe's Fish Guano and Potash.
- E. Frank Coe's Gold Brand Excelsior Guano.
- E. Frank Coe's Tobacco and Onion Fertilizer.
- E. Frank Coe's Vegetable and Vine Fertilizer.

Crocker Fertilizer and Chemical Co., Buffalo, N. Y.: —
- Crocker's Vegetable Bone Superphosphate.
- Crocker's Special Potato Manure.
- Crocker's General Crop Phosphate.
- Crocker's A. A. Complete Manure.
- Crocker's Potato, Hop and Tobacco Phosphate.
- Crocker's Ammoniated Wheat and Corn Phosphate.
- Crocker's New Rival Ammoniated Superphosphate.
- Crocker's New England Tobacco and Potato Grower.

Cumberland Bone Phosphate Co., Boston, Mass.: —
- Cumberland Phosphate.
- Cumberland Potato Fertilizer.
- Cumberland Concentrated Phosphate.
- Cumberland Fertilizer.

Chas. M. Cox & Co , Boston, Mass.: —
- Cotton-seed Meal.

L B. Darling Fertilizer Co., Pawtucket, R. I.: —
- Potato and Root Crop.
- Animal Fertilizer.
- Blood, Bone and Potash.
- Fine Bone,
- Tobacco Grower.
- Special Formula.
- Nitrate of Soda.
- Muriate of Potash.
- Farm Favorite.

John C. Dow & Co., Boston, Mass.: —
- Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
- Imperial Liquid Plant Food.
- Imperial Liquid Grass Fertilizer.

Elbert & Gardner, New York, N. Y.: —
Cotton-seed Meal.

Wm. E. Fyfe & Co., Clinton, Mass.: —
Canada Wood Ashes.

T. H. Frowley, Brookline, Mass.: —
Wood Ashes.

Great Eastern Fertilizer Co., Rutland, Vt.: —
Garden Special.
Vegetable, Vine and Tobacco.
Northern Corn Special.
General Fertilizer.
Grass and Oats.

Thomas Hersom & Co., New Bedford, Mass.: —
Bone Meal.
Meat and Bone.

F. E. Hancock, Walkerton, Ont., Can.: —
Canada Unleached Hardwood Ashes.

Thomas Kirley, South Hadley Falls, Mass.: —
Pride of the Valley.

Lowell Fertilizer Co., Boston, Mass.: —
Swift's Lowell Bone Fertilizer.
Swift's Lowell Animal Brand.
Swift's Lowell Potato Phosphate.
Swift's Lowell Market Garden Manure.
Swift's Lowell Fruit and Vine.
Swift's Lowell Lawn Dressing.
Swift's Lowell Tobacco Manure.
Swift's Lowell Ground Bone.
Swift's Dissolved Bone and Potash.

Lister's Agricultural Chemical Works, Newark, N. J.: —
Lister's Success Fertilizer.
Lister's Special Potato Fertilizer.
Lister's Celebrated Onion Fertilizer.
Lister's Special Tobacco Fertilizer.
Lister's High-grade Special for Spring Crops.

Lowe Bros. & Co., Fitchburg, Mass.: —
Tankage.

F. R. Lalor, Dunnville, Ontario, Can.: —
Canada Hardwood Ashes.

The Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
Mapes Bone Manures.
Mapes Superphosphates.
Mapes Special Crop Manures.
Economical Potato Manure.
Tobacco Ash Constituents.
Sulfate of Potash.
Sulfate of Ammonia.
Nitrate of Soda.
Double Manure Salt.

Geo. L. Munroe, Oswego, N. Y.: —
Pure Canada Unleached Wood Ashes.

McQuade Bros., West Auburn, Mass.: —
Fine-ground Bone.

E. McGarvey & Co., London, Ontario, Can.: —
Unleached Hardwood Ashes.

Niagara Fertilizer Works, Buffalo, N. Y.: —
Niagara Wheat and Corn Producer.
Niagara Potato, Tobacco and Hop Fertilizer.

Pacific Guano Co., Boston, Mass.: —
High-grade General Fertilizer.
Soluble Pacific Guano.
Potato Special.
Nobsque Guano.
Grass and Grain Fertilizer.
Pacific Guano with ten per cent. Potash.
Fish and Potash.
Special Potato Manure.

Packers Union Fertilizer Co., New York, N. Y.: —
Animal Corn Fertilizer.
Potato Manure.
Universal Fertilizer.
Wheat, Oats and Clover.
Gardeners' Complete Manure.

A. W. Perkins & Co., Rutland, Vt.: —
Plantene.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
Special Strawberry Brand Fertilizer.
Plymouth Rock Brand.
Special Potato Fertilizer.

Parmenter & Polsey Fertilizer Co. — *Con.*
- P. & P. Potato Fertilizer.
- Star Brand Superphosphate.
- A. A. Brand.
- Ground Bone.
- Muriate of Potash.
- Nitrate of Soda.

Prentiss, Brooks & Co., Holyoke, Mass.: —
- Complete Manures.
- Superphosphate.
- Nitrate of Soda.
- Muriate of Potash.
- Sulfate of Potash.

Quinnipiac Co., Boston, Mass.: —
- Quinnipiac Onion Manure.
- Quinnipiac Havana Tobacco Fertilizer.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Market-garden Manure.
- Quinnipiac Fish and Potash.
- Quinnipiac Grass Fertilizer.
- Quinnipiac Corn Manure.
- Quinnipiac Potato Phosphate.
- Quinnipiac Climax Phosphate.
- Quinnipiac Pure Bone Meal.
- Dissolved Bone-black.
- Nitrate of Soda.
- Muriate of Potash.
- Sulfate of Potash.

The Rogers & Hubbard Co., Middletown, Conn.: —
- Hubbard's Pure Raw Knuckle Bone Flour.
- Hubbard's Strictly Pure Fine Bone.
- Hubbard's Potato Phosphate.
- Hubbard's Fertilizer for All Soils and All Crops.
- Hubbard's Fertilizer for Oats and Top-dressing.
- Hubbard's Soluble Potato Manure.
- Hubbard's Soluble Tobacco Manure.
- Hubbard's Fairchild's Formula for Corn and General Crops.
- Hubbard's Grass and Grain Fertilizer.

N. Roy & Son, South Attleborough, Mass.: —
- Complete Animal Fertilizer.

Russia Cement Co., Gloucester, Mass.: —
- Essex Fish and Potash.
- Essex Potato Fertilizer.
- Essex Corn Fertilizer.
- Essex Complete Manure for Corn, Grain and Grass.
- Essex Complete Manure for Potato, Roots and Vegetables.
- Essex Odorless Lawn Dressing.
- Essex Dry Ground Fish.

Read Fertilizer Co., New York, N. Y. (D. H. Foster, general agent): —
- Read's Standard.
- Practical Potato Special.
- Bone, Fish and Potash.
- Vegetable and Vine.

Lucien Sanderson, New Haven, Conn.: —
- Sanderson's Old Reliable.
- Sanderson's Potato Manure.
- Sanderson's Formula A.
- Sanderson's Blood, Bone and Meat.
- Sanderson's Nitrate of Soda.
- Sanderson's Dissolved Bone-black.
- Sanderson's Sulfate of Potash.
- Sanderson's Muriate of Potash.

Standard Fertilizer Co., Boston, Mass.: —
- Standard Fertilizer.
- Standard Special for Potatoes.
- Standard Guano.
- Standard Complete Manure.

M. L. Shoemaker & Co., Limited, Philadelphia, Pa.: —
- Swift Sure Superphosphate for General Use.

F. C. Sturtevant, Hartford, Conn.: —
- Sturtevant's Granulated Tobacco and Sulphur.

Edward H. Smith, Northborough, Mass.: —
- Smith's Ground Bone.

Thomas L. Stetson, Randolph, Mass.: —
- Ground Bone.

The South Sea Guano Co., Boston, Mass.: —
- South Sea Guano.

E. A. Tompkins, Jamaica Plain, Mass.: —
- Ferti Flora.

Henry F. Tucker Co., Boston, Mass.: —
- Tucker's Original Bay State Bone Superphosphate.
- Tucker's Imperial Bone Superphosphate.
- Tucker's Special Potato Fertilizer.
- Tucker's Bay State Special.

I. S. Whittemore, Wayland, Mass.: —
- Complete Manure.

Darius Whithed, Lowell, Mass.: —
- Champion Animal Fertilizer.
- Flour of Bone.

The Wilcox Fertilizer Works, Mystic, Conn.: —
- Potato, Onion and Tobacco Manure.
- High-grade Fish and Potash.
- Dry Ground Fish Guano.
- Fish and Potash.

Williams & Clark Fertilizer Co., Boston, Mass.: —
- Ammoniated Bone Superphosphate.
- Prolific Crop Producer.
- Potato Phosphate.
- High-grade Special.
- Royal Bone Phosphate.
- Corn Phosphate.

Williams & Clark Fertilizer Co. — *Con.*
- Potato Manure.
- Grass Manure.
- Fish and Potash.
- Onion Manure.
- Bone Meal.
- Dry Ground Fish.
- Muriate of Potash.
- Sulfate of Potash.
- Nitrate of Soda.
- Dissolved Bone-black.

M. E. Wheeler & Co., Rutland, Vt.: —
- Superior Truck Fertilizer.
- Havana Tobacco Fertilizer.
- Potato Manure.
- Corn Fertilizer.
- Fruit Fertilizer.
- Royal Wheat Grower.
- Grass and Oats.

A. L. Warren, Northborough, Mass.: —
- Fine-ground Bone.

Sanford Winter, Brockton, Mass.: —
- Fine-ground Bone.

J. M. Woodard & Brother, Greenfield, Mass.: —
- Tankage.

Part II. — Report on General Work in the Chemical Laboratory.

CHARLES A. GOESSMANN.

1. Analyses of materials sent on for examination.
2. Notes on wood ashes and condition of the trade.

1. Analyses of Materials sent on for Examination.

During the past season 225 materials have been received, and the results of our examination have been published in detail in bulletins 59, 62 and 63 of the Hatch Experiment Station of the Massachusetts Agricultural College, together with the results of the official inspection of commercial fertilizers.

The responsibility of the genuineness of the articles sent on for examination rests in all cases with the parties asking for analyses, and our publication of results merely refers to the locality they come from. It is evident, from the increase each year of the number of materials sent in for analysis, that there is a growing interest taken in this work, and individuals are realizing the value of such chemical investigations.

The waste products of many industries are of such a nature that their value as manurial substances is unlimited and the current modes of manufacture are constantly undergoing changes which affect seriously their commercial manurial value. A frequent investigation of this class of materials cannot help but prove beneficial to the farmer, and hence arrangements will be made, as in previous years, to attend to the examination of these materials to the full extent of our resources. This work is carried on free of charge to the farmers of this State, the results of analysis being returned in the order of the arrival of samples at the office. Below

is given a partial list of materials received during the past season, which shows the general nature of the work: —

Wood ashes.
Sulfate of potash.
Muriate of potash.
Nitrate of soda.
Sulfate of ammonia.
Acid phosphates.
Sulfate of potash and magnesia.
Ground bone.
Complete fertilizers.
Minerals.
Liquid fertilizers.
Soils.
Dried pig's blood.
Lime-kiln ashes.
Glucose sugar refuse.
Damaged grain.
Insecticides.
Composts.
Refuse from glass factory.
Cotton-seed meal.
Cotton-hull ashes.
Tankage.
Wool shoddy.
Jadoo fibre.
Plaster.
Forage crops.
Soot.
Spent bone-black.
Brick-yard ashes.
Sludge.

These, together with other manurial products common to commercial and agricultural industries, are carefully investigated, and the results of our examination are free to those who may desire such information.

2. Notes on Wood Ashes.

This subject has engaged our attention for past seasons and has been discussed at length in previous reports.

During the past year (1899) 24.4 per cent. of the materials sent on for analysis consisted of wood ashes, as against 40.1 per cent. the previous year (1898).

The wood ashes sold for manurial purposes in our State are subject to official inspection, and the dealers in this commodity must secure a license to sell before they can legally advertise their article. The goods must be sold on a guaranteed analysis, stating their percentages of potash and of phosphoric acid present, and this analysis must be fastened to each package or car that contains them. As the dealer is obliged only to guarantee the amount of potash and of phosphoric acid present in the ashes, no objection can be raised regarding the amount of moisture, so long as the specified amount of those two elements is present. Wood ashes

ought to be bought and sold by weight and *not* by measure, for both moisture and the general character of foreign matters are apt to seriously affect the weight of a given volume.

	No. of Samples.	
	1898.	1899.
Moisture below 1 per cent.,	–	2
Moisture from 1 to 3 per cent.,	9	6
Moisture from 3 to 6 per cent.,	6	4
Moisture from 6 to 10 per cent.,	20	11
Moisture from 10 to 15 per cent.,	22	28
Moisture from 15 to 20 per cent.,	16	7
Moisture from 20 to 30 per cent.,	6	1
Moisture above 30 per cent.,	–	1
Potassium oxide above 8 per cent.,	4	4
Potassium oxide from 7 to 8 per cent.,	6	9
Potassium oxide from 6 to 7 per cent.,	8	13
Potassium oxide from 5 to 6 per cent.,	22	7
Potassium oxide from 4 to 5 per cent.,	25	19
Potassium oxide from 3 to 4 per cent.,	11	2
Potassium oxide below 3 per cent.,	3	2
Phosphoric acid above 2 per cent.,	6	4
Phosphoric acid from 1 to 2 per cent.,	60	43
Phosphoric acid below 1 per cent.,	13	10
Average per cent. of calcium oxide (lime),	33.60	34.10
Per cent. mineral matter insoluble in diluted hydrochloric acid: —		
Below 5,	1	–
5 to 10,	16	16
10 to 15,	31	26
15 to 20,	15	7
20 to 30,	13	5
Above 30,	–	2

Cotton-hull Ashes. — This waste product is receiving increased attention from the farmers, and is an article of great merit. The samples received this year analyze from 21 to 29 per cent. of potash, and are especially adapted to tobacco growing on account of the large proportion of carbonate of potash present, this form of potash being the most valuable one known for that purpose.

Sludge. — At the present time the larger cities are collecting all waste débris in reservoirs, and subjecting it to chemical treatment for recovery of fertilizing ingredients. This source of plant food is often within easy reach of the farmer, and may be turned to good advantage, as is seen

from the average analysis : nitrogen, 1.31 per cent. ; potash, .16 per cent. ; phosphoric acid, .86 per cent. ; lime, 1.13 per cent.

Hen Manure. — In this ingredient we have a very rich fertilizer and a material that is worthy of careful treatment. To save the nitrogen that otherwise might pass into the air a "fixer" is a necessity. Two samples received at the laboratory were analyzed, as follows : —

SAMPLES.	Nitrogen (Per Cent.).	Potash (Per Cent.).	Phosphoric Acid (Per Cent.).
Sample I.,	.46	1.12	.69
Sample II.,	.42	.43	.63

No. I. was treated with kainite, a material analyzing on an average 16 per cent. potash, and a substance capable of fixing the ammonia, thereby saving this element and at the same time supplementing the manure in potash, — the ingredient which it is deficient in. This application of an ammonia fixer may be applied to all animal refuse products, and, as is seen, has a twofold action, — the saving of nitrogen and the supplementing of potash.

Cotton-seed Meal. — This material still holds its own and is a recognized standard article, a source of nitrogen sought by tobacco growers. Its high standard has been maintained as in previous seasons.

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